

# **The Production of Subject-Verb Agreement in Slovene and English**

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## Declaration

I hereby declare that this thesis is of my own composition, and that it contains no material previously submitted for the award of any other degree. The work reported in this thesis has been executed by myself, except where due acknowledgement is made in the text.

Annabel Jane Harrison

# Abstract

This thesis explores the mental representation of subject-verb agreement, and the factors that can affect the determination of agreement in language production. It reports nine experiments that used a task in which participants produced sentence completions for visually presented complex subjects such as “The greyhound which two lively rabbits were tempting”. Such completions typically agree with the head noun (greyhound) as in “A greyhound which two lively rabbits were tempting is jumping” but sometimes agree with the local noun (rabbits) as in “A greyhound which two lively rabbits were tempting are jumping”.

The first experiments examined the value of the concept of markedness in subject-verb number agreement to see whether it has explanatory power for languages like Slovene with more than two number values. Results from two experiments employing complex sentence preambles including a head noun postmodified by a prepositional phrase or a relative clause (e.g., “The nudist(s) near the sand dune(s)”) show that Slovene number agreement differs from number agreement in languages with no dual, but that it is not possible to simply state that the singular is the least marked and the dual the most. I argue that using languages with more complex number systems allows greater insight into the processes of correct and erroneous subject-verb agreement, and shows that it is necessary to dissociate susceptibility to agreement from error-causing status. To conclude, the concept of markedness seems unable to explain my results.

Semantic effects in agreement are then examined using two comparison experiments in English. Experiment 3 shows that although English has only a two-value system, speakers are sensitive to semantic differences in number. Experiment 4 explores the possible influence of speakers’ native language three-value number system on their two-value second language system. It shows that native

speakers of English are more sensitive to semantic number differences in English than Slovene speakers of English.

Experiment 5 explores gender agreement in Slovene (which has three genders) and shows that there is a complex pattern of agreement. As with number, there is not just one number value which is problematic: neuter and masculine are most confusable, but masculine errors are also common when feminine agreement would be expected, thus suggesting that speakers revert to two different defaults, masculine and neuter.

Finally, the results of four experiments examining number and gender agreement in coordinated phrases are presented. Agreement in such phrases may be resolved (i.e. the verb agrees with the whole subject) but may instead agree with one conjunct. Agreement with one conjunct is affected by word order (agreement with the nearest conjunct is most common), coordinator (e.g., single-conjunct agreement is more common after “or” than “and”) and the gender or number of the conjuncts (e.g., dual number is associated with single-conjunct agreement).

Taken together, my results suggest that agreement is affected by a complex interplay of semantic and syntactic factors, and that the effects of a three-valued system are quite distinct from those of a two-valued system.

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# CHAPTER 1

## Literature Review

### 1.1 Overview

This thesis will explore the complexities of how subject-verb agreement is processed in production by investigating agreement in a language with relatively complex number and gender systems, Slovene. The relative contributions of semantics, word order and syntax will be investigated, with particular reference to how markedness affects agreement.

Agreement is a pervasive phenomenon in language, and it involves complex computations of dependencies between elements that can be separated. As a result, it represents a particularly challenging aspect of language production, and it is therefore surprising how relatively little it has been studied. Although there has been growing interest in it in recent years, it is still the case that most research has focused on languages with relatively restricted agreement systems (generally two genders at most, and two numbers). However, much more complex linguistic systems for agreement exist, and to develop a comprehensive account of agreement in language production, it is necessary to study such systems and to examine whether existing theories of agreement can be extended to them. This thesis sets out to do just that. It is important to carry out empirical work on agreement not just for psycholinguistic theories but also in order to check theoretical linguists' claims under controlled conditions.

I shall first present a review of the background literature, from theoretical linguistics and psycholinguistics. I attempt to show how agreement has been approached in the past and how it fits into current models of language production.

I then discuss the relevant features of Slovene in which the majority of the experiments are carried out.

In Chapter 2, I shall present evidence for an analysis of agreement production which relies upon syntactic markedness. Eberhard (1997) claims that the commonly-found asymmetry between plural attraction (agreement erroneously produced after a singular head noun followed by a plural local noun significantly more often than when the same head noun is followed by a singular local noun) and singular attraction or lack thereof (the rate of erroneous agreement produced after a plural head noun seems to differ little irrespective of local noun) can be explained by assuming that the plural has a marked feature whereas the singular does not. Having extended the model in order to deal with a more complex number system, I will report experiments which test this assumption.

I shall move on to present evidence for the role of semantics at all stages of agreement processing. Chapter 3 will present two experiments which replicate Slovene's three-way syntactic number distinction in English, which has a two-way number system, through the quantifiers *two* and *many*. The influence of the syntax of the speaker's native language on their second language production will then be investigated. I will show evidence against a direct influence.

The investigation will then be broadened to include not only number agreement but also gender agreement processing, and the role of markedness and semantics.

I will lastly present evidence from conjuncts agreement processing which shows that there is a role for linear order in agreement processing.

Together, these results argue for a model of agreement processing which incorporates information from later stages of processing than syntax, suggesting that syntax is not encapsulated but is influenced by feedback from other processes during production.

## 1.2 Language production models

The aim of this section is to introduce the basic architecture of the production system and the processing mechanisms involved in it, showing where agreement may take place and what issues its situation brings to the fore.

The greatest division between language models of production or comprehension is between those that assume a modular system (e.g., in production, Garrett, 2000; Levelt, 1989; Levelt et al., 1999; Ford et al., 1982; Frazier and Rayner, 1982, in comprehension) and those that do not (e.g. in production, Dell, 1986; MacDonald et al., 1994; Tanenhaus and Trueswell, 1995; Tabor and Tanenhaus, 1999, in comprehension). Although Fodor is often assumed to have been the originator of the modular view, his view of modularity was restricted to input systems and did not apply to subsystems or to production (Fodor, 1983, 1985). The motivations for a nonmodular system often emanate from comprehension evidence, since comprehenders make use of phonological, semantic and syntactic evidence as the message is unfolding (as shown by phonological priming; semantic priming; garden pathing), whereas it is generally from production that evidence is put forward for a modular system (e.g., early work on agreement processing; fluency and accuracy in speech production).

I will start by considering modular models, as in most models of language production, modularity is assumed (e.g., Garrett, 1975; Bock and Levelt, 1994; Levelt, 1989; Levelt et al., 1999). These models involve three principal levels: conceptualisation (the stage during which the message is encoded non-linguistically, also called the message level, Garrett, 1982); formulation, which proceeds in two separate, successive stages (Bock and Levelt, 1994; Garrett, 1980), the first being grammatical encoding, when semantic and syntactic (e.g., number and gender) properties of words are retrieved, constituting lemma selection, the second being morphophonological encoding, whereby form properties of words are retrieved, constituting lexeme activation (also called the sentence level); and articulation.

In this model, information flow between the levels is unidirectional, from the message towards phonological encoding (Bock and Levelt, 1994). Bock and Levelt (1994) provide evidence for the divisions that they make within the levels. It is instructive to work through an example sentence. Imagine that the message to be conveyed is 'I see the dog and the cat'. The first step discussed is lexical selection, which is when a lemma is chosen (e.g., 'cat'). A lemma is an abstract form of a word, which includes only syntactic information such as its part of speech (e.g., that 'cat' a noun), as well as gender (e.g., that 'cat' is feminine in Slovene)<sup>1</sup>, but no phonological information. This is clear since semantic substitutions tend to preserve meaning features, thus we are more likely to say

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<sup>1</sup>Levelt et al. (1999) have only grammatical features available; earlier models included semantic information in the lemma.

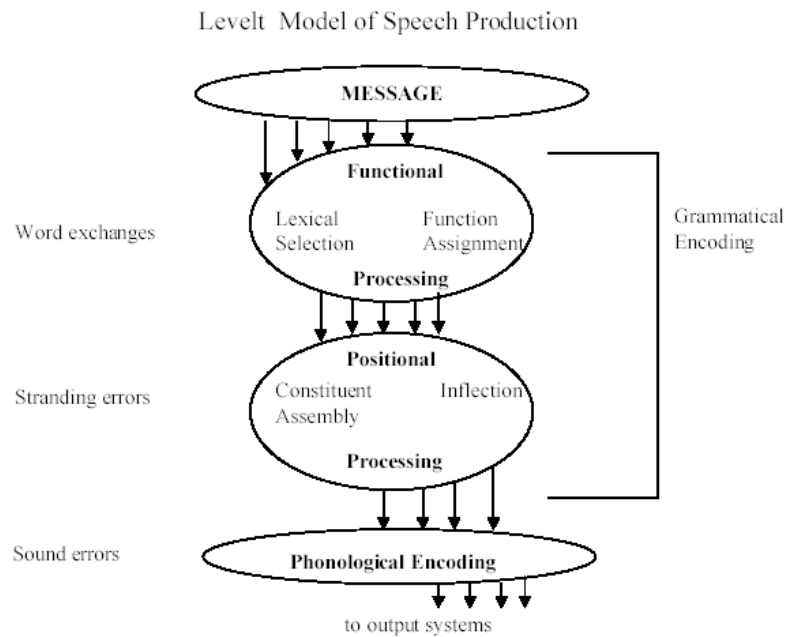


Figure 1.1: Language production model (from Bock and Levelt, 1994).

'I see the dog and the rabbit' than 'I see the dog and the went') Bock and Levelt (1994). Function assignment is the second step. This involves assigning syntactic relations or grammatical functions (e.g., subject and direct object), thus 'cat' and 'dog' would be designated objects and 'I' would be designated subject. The third step is constituent positional processing, when the order of the elements is specified. Evidence that this occurs after function assignment comes from exchanges of whole words, which tend to occur across phrasal boundaries (unlike phonological exchange errors, which tend to occur within the same phrase). Constituent positioning may be broken down into constituent assembly and inflection. Constituent assembly creates a syntactic hierarchy which controls word order and captures dependencies. Thus, the word order for the Slovene sentence would be fixed here as either [see [the dog and the cat]] (as in Figure 1.2) or [[the dog and the cat] see] (as in Figure 1.3).

The last grammatical encoding process, inflection, introduces morphophonology. This is separate and cannot be seen as mere phonological syllable insertion, since the errors involved are much more prevalent than would be expected from analogous phonological errors (Stemberger, 1985): speakers produce stranding errors like 'You ordered up ending some fish dish' instead of 'You ended up ordering some fish dish' (Garrett, 1993) and shift errors like 'I wasn't walk the dogging'. In our sentence, the verb would get its first person singular inflection,

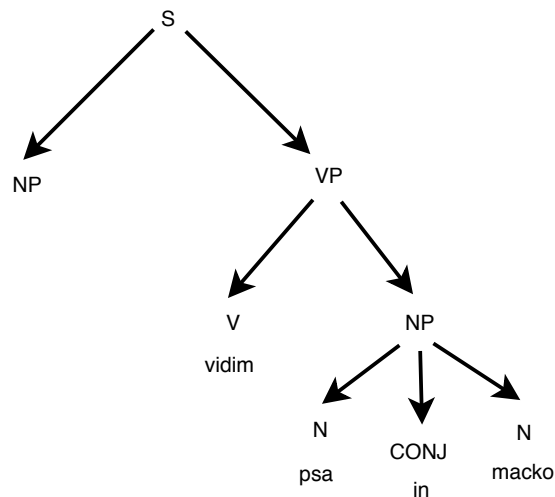


Figure 1.2: Verb-initial word order

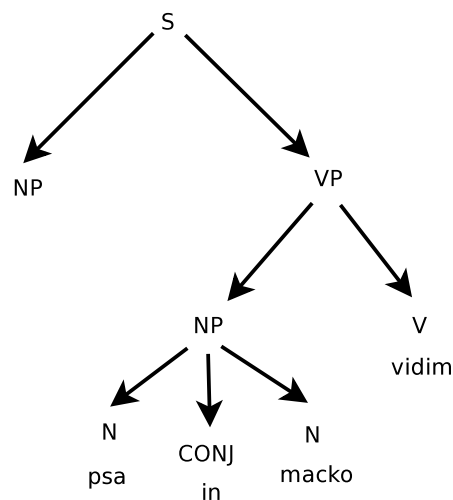


Figure 1.3: Verb-final word order

the objects their accusative inflections. After the grammatical encoding has been specified, phonological encoding can take place.

In this model, information flow between the levels is unidirectional, from the message toward phonological encoding as shown by the arrows in Figure 1.1 (Bock and Levelt, 1994). The system is also basically modular, with particular processing mechanisms to carry out particular processes which are unaffected by information elsewhere in the system, hence the circles in Figure 1.1 (Bock and Levelt, 1994). According to this model, agreement is primarily syntactic, thus it should not be affected by semantics apart from at the initial stage. There should

also be no influence of phonology on agreement, since phonological encoding occurs after grammatical encoding (including agreement).

### *Lexical selection*

Levelt (1989) proposed a framework of lexical access based on a network model. We refer to the words which are stored in our minds as the mental lexicon; this

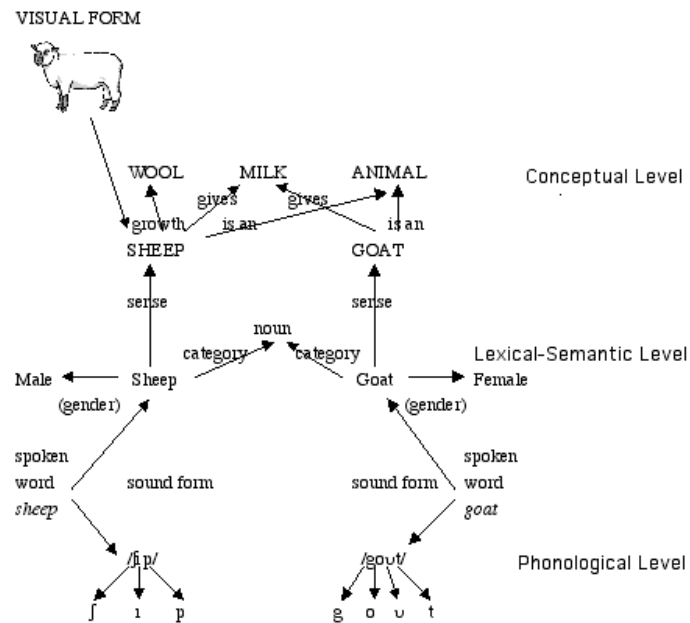


Figure 1.4: Part of lexical network. From Bock & Levelt (1984).

is what we must access in order to produce speech. According to this model, the knowledge which we have about each word in the mental lexicon involves semantic properties (the word's meaning), syntactic properties (part of speech, gender, argument structure; the word with its syntactic properties is referred to as a lemma) and morphophonological properties (its phonological form; a word with its form properties is referred to as a lexeme). As shown in Figure 1.4, within the network model, this information is represented at three different levels of representation, the conceptual level, the lemma level and the lexeme level. At the conceptual level, there are relationships (depicted by arrows) of a semantic nature, such as *isa* ('is a', e.g., a sheep is an animal). At the lemma level, nodes represent syntactic properties, with arrows connecting lemmas to syntactic categories (e.g., noun), gender (for nouns), transitivity and tense (for verbs), and so on. At the lexeme level, nodes connect the lexeme to ordered phonological segments (e.g., /ʃ/, /i/, /p/).

Lexical access involves spreading activation from the conceptual level to the lexeme level via the lemma level. Once a concept has been activated, all nodes attached to it will be activated. This explains semantic priming, whereby a form presented to a participant affects (in the case, facilitates) their response to another form, as when 'sheep' is activated, 'goat' will be activated via their shared nodes such as 'is an animal', 'gives milk', etc. Although the 'sheep' node will be the most activated, then, it may not be retrieved because all the concepts around it will also be activated, albeit indirectly and therefore less strongly, thus neighbours like 'goat' will also be candidates for activation.

In order to say the word a speaker has in mind, having retrieved the lemma, s/he must retrieve the lexeme. The evidence that lemmas are separate from lexemes and are retrieved first comes from numerous tip of the tongue studies (e.g., first noticed by William James, 1890; first systematically studied by Brown and McNeill 1966). When one tries to retrieve the lexeme, one often has the lemma information (e.g., its grammatical gender - Miozzo and Caramazza 1997; Vigliocco et al. 1997; or whether it is a count or mass noun - Vigliocco et al. 1999) as well as the meaning, but is unable to retrieve its form. This has been taken as evidence for lexemes being retrieved later than lemmas; however, it has been noted that there is often nongrammatical phonological information available in tip of the tongue (TOT) state as well, including syllable structure and initial sound (Miozzo and Caramazza, 1997; James, 1890). Miozzo and Caramazza (1997) note that initial phoneme is present at least as often as gender, and thus argue that phonological information must be accessible simultaneously with grammatical information; in fact, they further claim, based on data from Jescheniak and Levelt (1994), that sometimes phonological information is available when grammatical information is not).

There are two alternative views as to whether there are separate lemma and lexeme levels or not. On one view, phonological codes are themselves coded lexically as lexemes, and it is these lexemes which map onto phonemes (e.g., Levelt, 1989), whereas on another view, lemmas are mapped directly onto phonemes missing out the lexeme level entirely (Caramazza and Miozzo, 1997). Three types of lexical selection errors provide evidence for the division between the three levels: blends, exchanges, and substitutions.

Blends involve the combination of two semantically related words or phrases, e.g.,

- (1) The competition is a little stougher (Fromkin, 1973)

In the first example, it would appear that spreading activation has caused two synonyms, *stiffer* and *tougher*, to be activated, which have then been blended. This is problematic because although both must have been activated at the conceptual level, the blending occurs at the phonological level, but the fact that it is systematic (respecting syllable constituency) means that it must occur at this stage (Garrett, 1980). Exchange errors involve two words (over 80% of the time, from the same part of speech - Garrett, 1980; Stemberger, 1985) in a phrase exchanging position, whilst the rest of the phrase remains the same, e.g.,

- (2) Seymour sliced the knife with a salami (Fromkin, 1973)
- (3) I got into this guy with a discussion (Garrett, 1980)
- (4) Most cities are true of that (Stemberger, 1985)

Example 2 involves the exchange of bare nouns - *knife* for *salami*; it would appear that in Example 3, however, the full NPs have been exchanged - *this guy* for *a discussion*, thus it is probably an error in syntactic rather than lexical processing. Example 4 (intended: *That is true of most cities*) shows that not only are two noun phrases (*that* and *most cities*) exchanged, but this happens before the production of the agreement on the verb, since it matches the plural erroneously produced subject rather than matching the intended singular subject. The existence of lexical errors means that the two lexical items are concurrently active at the moment when the first of the two words is inserted into the syntactic frame. Since the two words belong to different phrases in the same clause, we can conclude that the scope of grammatical encoding is, at least, the clause and not smaller units such as the phrase.

Substitutions, as the name suggests, involve errors where one lexical item is exchanged for another, e.g.,

- (5) CREAM AND BUTTER (Newkirk et al., 1980)

Example 5 is a mixed error - so called because it involves semantic and phonological exchange<sup>2</sup>. This type of error is disproportionately common compared

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<sup>2</sup>Example 5 is from ASL, and the sign for BUTTER forms a minimal pair with SUGAR differing only in place of articulation, which it shares with the sign for CREAM.

to pure semantic and pure phonological errors. It is a potential problem for a system which allows neither feedback nor any other kind of interaction between the lemma level and the lexeme level, since semantics should be accounted for and the lemma chosen before phonology can begin to intervene. These theories (e.g., Levelt, 1989) can only explain this type of error in terms of self-monitoring: before articulation is initiated, the monitor can detect an error in the phonetic plan for the word *unarmed*; however, since phonologically related words including *unharmed* are also activated, the monitor erroneously allows the incorrect *unarmed* to be articulated. Garrett (1993) proposes that mixed errors are due to environmental contamination rather than any lexical feedback.

Levelt et al. (1991) provided evidence for a two-stage theory with a picture naming task. They examined semantic and phonological distraction with three different intervals between the presentation of the picture and the onset of the distractor (stimulus onset asynchrony or SOA). Participants also had a (button press) lexical decision task whilst their response time was measured. The latency for the two different types of distractors at the three different SOAs fitted best with a two-stage (compared to a connectionist or a cascade) model. Further consistent evidence comes from Schriefers et al. (1990)'s experiment comparing picture naming with picture recognition, which showed that the semantic inhibition effect was indeed at the lemma and not the conceptual level, since picture recognition did not show any effects of semantic inhibition, thus providing evidence for the differentiation of separate conceptual and lexeme levels. Schriefers et al. (1990)'s experiment compared semantic and phonological distractor words. The semantic distractors caused inhibition at an SOA of -150ms. Phonological distractors, however, produced a facilitation effect at between 0 and +150ms, suggesting that phonological encoding takes place after lexical selection.

More recently, Vigliocco et al. (2002) showed that semantics and syntax were processed at different levels by examining whether there are semantic interference effects in a gender task. Participants were presented with blocks of English words which they had to translate into Dutch (which has both neuter N and common C genders), adding a size adjective which corresponded to the size of font they saw the word presented in, e.g., if they were presented with Example 6 in small font, then the target was Example 7, or if they were presented with Example 8 in large font, then the target was Example 9<sup>3</sup>. Words presented in one

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<sup>3</sup>Here and throughout this thesis, I use the morphological gloss conventions of Leipzig Glossing Rules (LGR). The most commonly used abbreviations are shown in Appendix A.

block could be all from the same semantic category (as opposed to from different semantic categories), and they could either be all one gender, or a mixture of common and neuter gender. Participants' response times were decreased if the target nouns were of the same semantic category (compared to different categories) and increased if the target nouns had the same gender (compared to if they had different genders). These factors did not interact, suggesting a feed-forward flow of activation between lexico-semantic and lexico-syntactic information.

- (6) cat
- (7) klein-e Kat  
small-C cat.C  
'small cat'
- (8) horse
- (9) groot Paard  
big.N horse.N  
'big horse'

#### *Function assignment*

After lexical selection has been achieved, the next step is function assignment. The most important problem of function assignment is in specifying which elements of a syntactically complex upcoming utterance will be the subject and, where applicable, which will be object(s) (Bock and Levelt, 1994). Although the selection of syntactic role is partially dependent on the message itself, grammatical encoding involves more than a mere transfer from agent role to subject or from patient role to object, as the following examples show:

- (10) My brother was beaten up (by the bully)
- (11) The bully beat my brother up

In the first example, the agent (the person doing the bullying)'s inclusion is optional and, when it is included, it is not the subject but is included in a prepositional phrase; the patient or object of the bullying is not in object position, but is promoted to subject position. In fact, there is no substantial difference at the message level between the two sentences, yet they differ as to the nouns' grammatical functions. Note that word order is not the issue here, but case assignment; this is clear from the following Slovene example in which both subject verb object and object verb subject word orders are acceptable.

- (12) medicinska sestra je brcala čarovnico  
 nurse.NOM AUX kick.PPL witch.ACC  
 ‘The nurse kicked the witch’
- (13) čarovnico je brcala medicinska sestra  
 witch.ACC AUX kick.PPL nurse.NOM  
 ‘The nurse kicked the witch’

The claim that there is a process of functional assignment and that it is separate from constituent assembly (i.e. word order) is suggested by phrase exchanges including case-marked pronouns, e.g.,

- (14) You must be too tight for them (Stemberger, 1982)

for ‘They must be too tight for you’; case marking has clearly taken place correctly, thus it is the functional assignment which has failed; we do not see errors where case marking occurs to the wrong items but in the right place, e.g.,

- (15) \* You must be too tight for they

Likewise, agreement tends to be not with the intended subject but rather with the erroneously produced one (e.g., Example 4 above). The correct case marking and agreement strongly suggest that these errors are function assignment errors not mere word exchange errors.

There is also experimental evidence supporting the differentiation of functional and positional assignment. Bock et al. (1992); Bock (1986) presented participants with a prime sentence which used one of two different syntactic structures (active or passive) and subsequently asked them to produce a sentence themselves in order to describe a picture. As predicted, the structure which they had just been exposed to influenced the structure which they went on to produce themselves, namely, they were more likely to produce a passive sentence if they had just heard a passive sentence. The results showed independent effects of priming the structure and the conceptual features of the elements (Bock et al., 1992).

Functional assignment may be controlled by thematic roles (as discussed above) or by discourse factors. For instance, in a passive sentence, the theme is not assigned the object role, as discussed above, but the subject role. The reason for this may be semantic (e.g., animate entities are more likely to be placed in subject

position than inanimate entities, as shown by McDonald et al. (1993); concrete entities are more likely to be placed in subject position than abstract entities, as shown by Bock and Warren (1985)) but are also strongly influenced by discourse factors (see Ferreira and Yoshita, 2003); given (as opposed to new) information is more likely to appear early and in subject position in a sentence (Tomlin, 1986). According to the accessibility hierarchy (Comrie and Keenan, 1979; Keenan and Comrie, 1977, 1979), the subject is most likely to be relativised. The subject is assumed to be assigned first in their model (Bock and Warren, 1985). Animate entities are more likely to be subjects and therefore to control agreement.

It has been suggested that verbs control function assignment (Bock & Levelt, 1994), since verbs are generally assumed to assign thematic roles (e.g., *see* would assign the role agent to *I* and theme to *the dog and the cat* in our example) and from them, grammatical functions (e.g., *I* subject, *the dog and the cat* object).

#### *Constituent assembly*

Constituent assembly occurs after function assignment, as stated above. Bock & Levelt (1994) claim that sequence is imposed in a hierarchical fashion. There is evidence for this from formal linguistic analysis, speech errors, errors in sentence recall and pauses in speech.

Firstly, subject-verb agreement shows that the verb agrees with something other than the element next to it (under normal circumstances). In Example 16, the nearest element is actually singular, and in Example 17, it is plural. Likewise, we require hierarchical structure in order to explain the ambiguity of sentences like 18 where the adjective could qualify one or both animals.

- (16) The dog and the cat are running away
- (17) The dog (not the cats) is running away
- (18) The fierce dog and cat were running away

The majority of sound exchange errors (87%) occur within the same clause, and word exchanges may occur in adjoining clauses (20%), leading Garrett (1980) to the conclusion that two clauses is the maximum that can be planned. Ford and Holmes (1978) provide further evidence for clause encapsulation. Participants showed increased reaction times to the tones which they heard during speech at the ends (compared to at the beginnings) of clauses. These were taken as

an index of processing load during production, suggesting that planning units are at the clause level. We shall see later that there is some evidence for clause encapsulation from the agreement literature too.

Constituent structure seems to rely on grammatical categories and syntactic functions of the lemma constituents. There is experimental evidence for this from Bock and Loebell (1990), who showed in a syntactic priming task that differing event roles and differing prosodic patterns had no effect on participants' tendency to repeat a recently encountered syntactic structure. Participants were presented with a prime sentence like Examples 19-21

- (19) The wealthy widow gave an old Mercedes to the church
- (20) The wealthy widow drove an old Mercedes to the church
- (21) The wealthy widow sold the church an old Mercedes
- (22) The boy gave the apple to the teacher
- (23) The boy gave the teacher an apple

The dative and locative priming conditions (Examples 19 and 20) resulted in an increased use of the prepositional dative form in the target (e.g., Example 22 rather than 23) compared to the baseline (Example 20) which had a more similar surface structure than the double object construction. As discussed above, however, subject and object roles can be primed. This suggests that constituent structure is controlled by grammatical categories and syntactic functions. I assume that the constituents are noun phrases, verb phrases, and so on.

Bock and Levelt (1994) assume that information is passed from one stage to the next in a cascading fashion. This means that the order in which elements appear in speech can be a reflection of how information has been computed and delivered from the previous stage.

### *Inflection*

The last grammatical encoding process is inflection. This stage includes the specification of things like definiteness, which, in English, are not strictly morphological processes, but involve the use of closed class words like *the* and *a*. Apart from for cross-linguistic consistency, one reason to include closed class words with morphological affixes is that they behave similarly in speech errors.

Function words (e.g., determiners, auxiliaries, prepositions) and other closed class elements (e.g., a noun's plural *-s*, a verb's singular *-s* or past tense *-ed*) are much less likely to be involved in speech errors (blends, semantic or phonological substitutions, exchanges) than open class words (Garrett, 1990). Closed class words are also absent from the speech of some aphasic patients, although their higher frequency would be expected to make them more common than less frequent words (Saffran et al., 1980).

There are two accounts of such evidence for discrepancies between open and closed class words. The first comes from Garrett (1982), who argued that closed class elements are the features of a grammatical frame. Closed class elements, he claimed, frame the sentence, specifying definiteness, tense, number and other grammatical features of the open class words. Open class words, meanwhile, have to be assigned grammatical functions. Thus, closed class elements would have their place in the syntactic tree pre-defined, whereas open class elements would need to slot in, as in in Figure 1.5. Clearly, then, open class elements

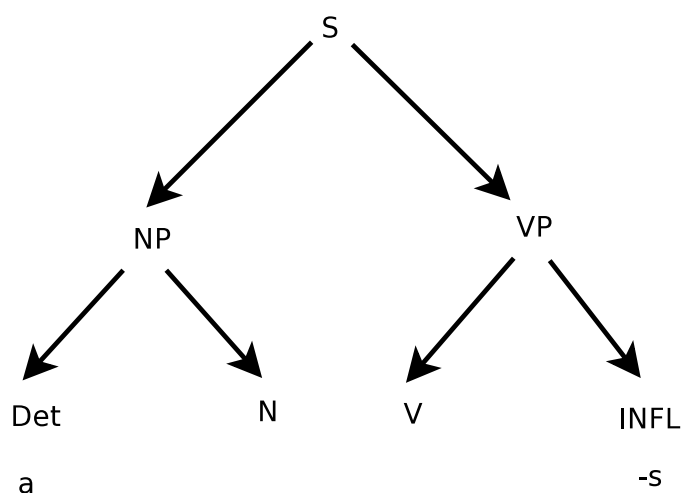


Figure 1.5: Open class elements slotting in Garrett (based on 1982)

would be more subject to exchange than closed class elements.

If there is a syntactic frame, then we might expect that the whole frame is primed (i.e. tense and agreement and function words) but later research has shown that tense and agreement are irrelevant to priming (Pickering and Branigan, 1998). Bock (1989) found priming between *to* and *for* prepositional phrases in ditransitive sentences such as

- (24) The witch making the sandwich for the knight  
 (25) The fairy giving the cake to the swimmer

suggesting that individual function words were irrelevant to priming.

An alternative explanation for the differences between open and closed class elements comes from frequency. Less frequent items are more likely to participate in errors than more frequent items, and since closed class elements are vastly more frequent, this perhaps insulates them from errors to some extent (Dell, 1990; Stemberger, 1985). Secondly, structural repetition (syntactic priming) is not dependent on individual closed class elements: varying the preposition does not alter the tendency for participants to repeat a given structure (Bock, 1989), though altering the structure whilst keeping the prepositions the same also has little effect (Pickering et al., 2001b). On the basis of such evidence, Lapointe and Dell (1989) proposed that whilst the slots for particular closed class elements would be in place, in the case of closed class words, they would be more abstract, as in Figure 1.6, whereas the inflectional affixes would still be directly specified. Evidence for this alternative treatment of words and bound morphemes came

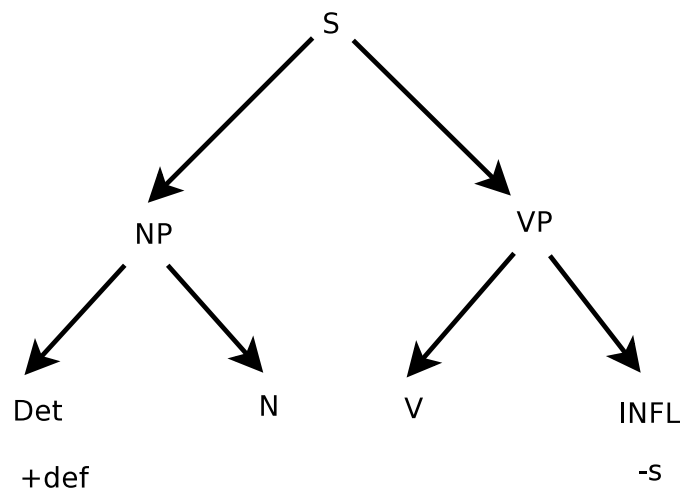


Figure 1.6: Some closed class elements specified, others not (based on Lapointe and Dell, 1989)

from (Lapointe, 1985), who found that both English- and Italian-speaking aphasics treated function words and bound morphemes differently, with the former being omitted, whilst the latter were more often replaced with other affixes. This suggests that, unlike function words, affixes are irreplaceable to the frame. According to this view, there are three different types of elements which can be

slotted into the frame: morphological affixes (which are specified in the frame itself), function words (which have their own specified slots for which there is only one possible filler), and open class words (which can slot in anywhere provided that they fit the criteria of such things as grammatical category, and in the case of errors, perhaps when they do not). Thus, both function words and open class words go through the same processes and are subject to the same risk of phonological encoding errors, as shown in error elicitation experiments (Dell, 1990).

There are two types of speech errors in support of the claim that inflection is generated at the positional level: morpheme stranding and shift errors. Morpheme stranding involves the substitution of the intended lemma (e.g., *end*) for another (e.g., *order*) but the bound morphemes (in this case, *ed* and *ing*) are left stranded, e.g.,

(26) You ordered up ending some fish dish (Garrett, 1993)

Shift errors are errors of placement of syntactically active bound morphs (i.e. inflection), e.g.,

(27) he get its done (Garrett, 1993)

for *he gets it done*. These errors show that bound morphemes are accessed separately from words, since they are much more prevalent than would be expected from analogous phonological errors (Stemberger, 1985). The frame model and the mixed model would both analyse morpheme stranding errors as successful frame generation but unsuccessful lexical access, however, shift errors are a problem, since they imply that an incorrect frame has been produced.

Garrett claimed that such shift errors which attach morphemes to stems irrespective of grammatical category took place at the positional level and word exchange errors at the functional level, thus providing evidence for the division of the two different levels. Fromkin (1980) provides at least one counter-example:

(28) Rosa always date shranks (Fromkin, 1973)

for *Rosa always dated shrinks*, where not only are the morphemes exchanged (which would yield *Rosa always dates shrinked* with the regular *-ed* morpheme shifted),

but it is the unrealised past feature which has moved from the verb to the noun, whilst the plural feature has remained, thus this is not a phonological error. These types of errors are extremely uncommon, however (Garrett, 1980). Stranding errors are often taken as evidence that words are inserted into the sentence with their syntactic category already specified (i.e. that lemmas are specified before the positional level) So how are bound morphemes brought into the frame? When a lemma is selected, the information about what morphemes it can be used with is present, thus if the message involved animals, whilst the selection of *goat* would require the addition of the *s* morpheme to produce the plural, the selection of *mouse* or *sheep* would require different treatment. These specifications are said to be directly incorporable into a structural frame (Bock & Levelt, 1994).

Bock & Levelt (1994) claim that when the specifications are not part of the message, or have already been specified, as they argue is the case for agreement, the redundant re-specification information comes from the lemma.

### 1.2.1 Feedback

Other theories propose that there is more interactivity between modules (e.g., Dell, 1986; Harley, 1993; Stemberger, 1985; Vigliocco and Hartsuiker, 2002). Dell (1986) proposes separate nodes for all morphemes, affixes, both inflectional (e.g., plural *-s*) and derivational (e.g., agentive *-er*) as well as bare words (e.g., *dance*), and for complex words (e.g., including a plural *dances*, including an agentive affix *dancer*). Inflectional affixes are represented at both the morphological and the syntactic level (whereas derivational affixes are only represented at the morphological level), capturing the difference between the two in terms of chronology, as the derivational morphology is usually assumed to be lexicalised and thus stored whereas inflectional morphology is assumed to be created on the fly<sup>4</sup> (as shown in Example 29 and 30).

(29) dance-er-s

dancers

(30) dance-s-er

\* danceser

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<sup>4</sup>It is not universally accepted that inflected forms are not stored (Alegre and Gordon, 1999) but most agree that there is some difference between inflectional and derivational morphology.

The syntactic frame is built on the basis of semantic representation and activated word nodes.

In contrast to the modular theories discussed above, constraint satisfaction theories, which were originally developed in the context of work on language comprehension (MacDonald et al., 1994; Trueswell and Tanenhaus, 1994; Bates and MacWhinney, 1989), propose that processing is determined by the interaction of multiple graded, probabilistic constraints. It is non-encapsulated, thus semantics, morphology, phonology and linear word order can potentially interact with syntax even if agreement is a primarily syntactic process. In a less strong version of the nonmodular approach, Dell (1986) proposes local interactivity (with feedback from one level to another). The approach is attractive for a number of reasons.

Firstly, as indicated above, there are a number of speech errors which suggest interaction between the different levels. Mixed errors have such a high probability, that numerous researchers (e.g., Dell and Reich, 1981) have concluded that phonological similarity actually increases the probability of semantic substitution.

Secondly, the availability of (limited) phonological information when in a tip-of-the-tongue state (i.e. when only the lemma and not the lexeme is available) suggests that there must be feedback from the phonological level even when (for independent reasons stated above) we believe that the lexeme is not available).

Schriefers et al. (1990) also tested whether phonological encoding strictly follows lexical selection. They tested whether phonological distractor words (e.g., *sheet*) would cause stronger facilitation than an unrelated word (e.g., *house*) when a picture (e.g., of a sheep) had to be named. This phonological facilitation occurred at +150 milliseconds (i.e. when presented 150ms before the onset of the picture) whereas the semantic inhibition occurred at -150ms (i.e. when presented 150ms after the onset of the picture), thus suggesting that phonological encoding strictly follows lexical selection.

Vigliocco and Hartsuiker (2002) propose a combination of feedback and maximal input. They divide theories of agreement into two types, maximal and minimal, where maximal means that input is not restricted, and minimal means that it is. In the case of minimal input, the input which the encoder receives from

conceptual structure is restricted to use at the message level (perhaps with feedback and / or monitoring in order to explain any conceptual effects found in syntactic production). In contrast, according to the maximal input hypothesis, the input information from the conceptual structure may be used for other purposes (e.g., in production, this means in practice that there may be late semantic influences in what the minimal input hypothesis would term purely syntactic processes, without needing to appeal to feedback or monitoring). Vigliocco and Hartsuiker (2002) (along with Levelt, 1989) propose that feedback is necessary for language acquisition and furthermore, that adults also use feedback. Adults may use phonological form information to infer grammatical features, for example stress location to infer grammatical class (Kelly, 1992); morphophonological form to infer gender (Bates et al., 1985); phonological form is related to meaning (Shillcock, 2000) though there is no evidence yet that it is used to infer meaning. Since adults are sensitive to this information, it is likely that it could be used in acquisition, and the correlations are still available to speakers in adulthood, thus they may be used during normal language processing.

Vigliocco and Hartsuiker (2002) also point out that there is evidence that feedback has been shown to be used for connectivity in the brain, thus a model incorporating feedback is consistent with neurobiological constraints. Postma (2000) has observed that feedback from sublexical to lexical representations in a Dell (1986)-type model increases accuracy and efficiency by increasing the activation level of the target relative to incorrect sublexical units. This combines the advantage of cascading activation and the directive function of feedback. Dell et al. (1997) propose that feedback from the phonological level to the lemma level could serve to indicate whether the phonological code is ready or not, which would again ensure both efficiency and accuracy.

### 1.2.2 Conclusion

There is much dispute about whether or not there is feedback from lower levels to higher ones and this will be discussed in more detail in this thesis. A three level process of language production with a syntactic-morphological layer intervening between the message and its phonological form will be assumed, along with Dell's (1986) spreading activation model of lexical selection.

### 1.3 Aspects of agreement relevant to Slovene

What counts as agreement has been fiercely disputed. The issues at stake are illustrated by a few definitions of agreement shown below.

An early definition (circa 1800) comes from the dictionary writer Webster: “When one word stands connected with another word, in the same number, case, gender, and person”, but this is both too specific (number and gender may not be the same, as in two singular conjuncts with plural agreement; masculine and feminine conjuncts which do not show agreement with both genders) and too all-encompassing (it includes case, for instance).

A contemporary definition of agreement comes from the Summer Institute of Linguistics: “Agreement refers to a formal relationship between elements whereby a form of one word requires a corresponding form of another.” This is still too vague - one usually excludes case, on the grounds that although there is a dependency relation between the case-marker and the case-marked element, they do not share a property but rather one imposes a different property on the other. It also appears to exclude semantic agreement. Steel’s (1978, cited in Corbett, 1991) definition is better:

The term *agreement* commonly refers to some systematic covariance between a semantic or formal property of one element and a formal property of another. For example, adjectives may take some formal indication of the number and gender of the noun they modify. (Steel, 1978, p.610, cited in Corbett, 1991, p.4)

Case is excluded here because it is not the property of a preposition but only of the noun phrase, and we can include semantic as well as syntactic agreement.

Agreement refers to a systematic covariance of linguistic forms. There are two different approaches to this: directional and non-directional. The first assumes, as the word suggests, that one element agrees with the other. The second assumes unification of elements.

A derivational theory (e.g., GB) is directional, assuming a process that copies or moves agreement features (in a fully specified bundle) from one element, the agreement controller (e.g., the subject), to another element called the agreement

target (e.g., the verb); all of the agreement information is thus provided by the controller. This is the approach assumed by Corbett.

A constraint-based theory (e.g., HPSG, LFG, CCG) assumes no directionality; rather, an agreement relation exists between the two elements, with both contributing to the totality of agreement information (although a particular element may be underspecified with regard to agreement, thus all of the information may happen to come from another particular element); the two elements and associated information are unified, thus providing all of the agreement information. This is the approach assumed by Moravcsik (1978). The following two Slovene sentences may serve as examples:

- (31) brat je bil debelejši od sestre  
 brother AUX.SG be.PPL.M.SG fatter.M.SG than sister  
 ‘the brother was fatter than the sister’
- (32) Saša je bil debelejši od sestre  
 Saša AUX.SG be.PPL.M.SG fatter.M.SG than sister  
 ‘Sasha was fatter than his sister’

In Example 31 above, according to a directional theory of agreement, we would say that the auxiliary verb agrees with the singular number of *brat*, and the participle *bil* and the adjective agree with the masculine gender and the singular number. In contrast, according to a non-directional theory, singular, *brat* and *bil* are all indexed as masculine singular; *brat*, *je* and *bil* are all indexed as singular; *debelejši* can be masculine singular; thus they can unify. In Example 32, according to a directional theory of agreement, we would say that the auxiliary verb agrees with the singular number of *Saša*. Since the name is ambiguous with regard to gender, the gender would have to be resolved (for example by context in the case of production) so that the correct (masculine) lexeme was chosen, then the participle and the adjective agree with the masculine gender too. According to a non-directional theory, however, the lexeme *Saša* would be underspecified with regard to gender and thus able to combine with *brat*, *bil* and *debelejši* which are all indexed as masculine singular (along with other possible interpretations<sup>5</sup>). The problem of having to specify two (or more) lexemes for gender-

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<sup>5</sup>There is a great deal of syncretism (i.e. the same phonological form being used to represent different morphemes) and it is not systematic. Thus, the underspecified features of a form like *debelejši* would have to include all possible interpretations: masculine singular, feminine dual and masculine plural in the nominative; this is clearly stretching the interpretation of underspecification.

ambiguous names like *Saša* also holds for words like 'I', 'you', etc. and for some number-ambiguous count nouns like *sheep* in English or *città* 'city' in Italian. Similarly, syncretism creates a serious redundancy problem in derivational theories, since each form must be specified multiple times. In Slovene, there are two dimensions which are differentiated in the masculine singular only: animacy (accusative only) and definiteness (nominative and inanimate accusative only)<sup>6</sup>, thus if each of these requires a feature, there would be a vast deal of redundancy. Thus for every adjective, 504 criteria (72 different morphological forms, relating to number, case, gender, definiteness and animacy) would need to be specified.

Underspecification (only specifying case, number and gender or person, as in English) would lead to less redundancy, with a maximum of 144 needed (24 morphological forms)<sup>7</sup>.

Pollard and Sag (1994) differentiate three types of agreement:

- index agreement (which includes most types of agreement discussed here - not case; indices are required to be token-identical)
- syntactic agreement (e.g., case concord; strictly syntactic)
- pragmatic agreement (e.g., honorifics; contextual background assumptions are required to be consistent)

I shall be concerned with only the first type. Loosely within the first type, Anderson (2004) distinguishes two sorts of agreement:

- Agreement between modifiers and the heads of their phrases; and
- Agreement between 'Predicates' (including V, Adj, Prep, and possessed N) and their arguments.

I will employ this division to discuss different agreement targets.

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<sup>6</sup>There are two exceptions to this masculine-only definiteness differentiation which involve alternation with feminine and neuter singular too, namely indefinite *majhen, majhna, majhno* 'small', *vêlik, velika, veliko* 'big' versus definite *mali, mala, malo* 'small', *vêliki, vélika, véliki* 'big'.

<sup>7</sup>NB The redundancy would be reduced much further in a language with more systematic syncretism like German.

## 1.4 Agreement targets

### 1.4.1 Agreement between modifiers and heads of their phrases

This type of agreement includes adjectives agreeing with nouns, determiners and quantifiers agreeing with nouns (or vice versa).

#### *Determiners and demonstratives*

In English, there are special forms of some determiners (e.g., *this* for singular versus *these* for plural; *a / an* for singular count nouns versus *some* for plural count nouns and uncountables) but unlike in languages with grammatical gender such as Slovene, otherwise, there is no agreement between modifiers and the heads of their phrases.

In Slavic languages, there are often no determiners, but gender and number (the latter sometimes subsuming the distinctions of the former) are marked on demonstratives, e.g. in the first Slovene example there is masculine (singular) gender agreement, in the last there is different number agreement,

(33) tist-i lep-i fant  
 this-M pretty-M.DEF boy.M  
 'That pretty boy'

(34) tadv-a lep-a fanta  
 those.two.M.DU pretty-M.DU boy.M.DU  
 'Those two pretty boys'

There are various types of specifier-noun agreement in different languages; even those which do not have determiners have other ways of expressing agreement.

#### *Adjectives*

Adjectives can show gender and number agreement. They may be underspecified for gender (for instance, in French, adjectives ending in *e*, e.g., *maigre* 'thin', the feminine agreement - usually *e* - is not visible or audible) and number (for instance, in French, adjectives ending in *s*, e.g., *gros* 'fat', plural agreement - usually *s* - is not visible or audible), or may be specified for neither, such as adjectives derived from nouns *krem*, *roza*, *blond*, e.g.,

- (35) brat ima zelen-e oči in blond-0 las-e  
 brother has green-F.PL eyes.F.PL and blond-0 hair.M-PL  
 'My brother has green eyes and blond hair'

where *blond* lacks any agreement but *zelen* 'green' shows gender and number agreement.

There are various types of adjective-noun agreement in different languages (including none at all in English<sup>8</sup>), but some specific adjectives may fail to show agreement even in languages which do otherwise show agreement.

### Numerals

Number may be marked on numerals, for instance in Slavic languages, gender and number (the latter sometimes subsuming the distinctions of the former<sup>9</sup>) are marked on numerals, e.g. (from Slovene),

- (36) dva fanta  
 two.M.DU boy.M.DU  
 'two boys'
- (37) dve punc  
 two.F.DU girl.F.DU  
 'two girls'
- (38) tri punce/ tri-je / fantje so sedeli/e  
 three.F girl.F.PL / three.M boy.M.PL AUX.PL sat.F/M.PL  
 'Three girls / boys were sitting'
- (39) pet / sto / veliko lepih punc /  
 five / a hundred / big pretty.PL.GEN girl.F.PL.GEN /  
 fant-ov je sedelo  
 boy.M.PL.GEN AUX.SG sat.N.SG  
 'Five / a hundred / a lot of pretty girls were sitting'

Agreement may be variable according to gender (especially below number 5), as in Example 38, whereas larger numbers may be completely invariable (as in nominative numerals above 5, e.g., Example 39), and there may be variation within a single language (though it may be uniformly absent, as in English). Number

<sup>8</sup>Arguably, English has gender agreement for the French-derived adjective *blond(e)*, but this is somewhat inconsistent and the feminine form is mainly used as a noun.

<sup>9</sup>This is classically the case in Russian, where the plural fails to show gender.

phrases in Slavic languages differ from English and Western European languages since from the number 5, they involve the use of the genitive (as partitive) and subsequent agreement can be (in Slovene, is obligatorily) singular, as in Example 39.

Numerals themselves show agreement in some languages; numerals can vary as to gender or noun class.

### *Conclusion*

There are many different types of agreement between modifiers and heads of their phrases: determiners, demonstratives, numerals, possessives, adjectives; many of them are not independent, but whether they show agreement or not is dependent on the presence or absence of another of them; some agreement between modifiers and heads of their phrases differs from that of the same part of speech as predicate.

#### *1.4.2 Agreement between predicates and their arguments*

##### *Verbs*

This type of agreement includes verbs, which can agree with their subject or with their object, e.g. (French),

- (40) cettes fille-s, je les ai frappé-es  
 these.F.PL girl.F-PL I them have.1.SG hit-F.PL  
 'These girls, I have hit them'

Here the participle 'hit' only agrees with (and therefore differs in) the object, though the main verb agrees with the subject.

Subject-verb agreement may vary according to word order. Several languages of the world show only partial agreement with certain word orders. In Arabic, number agreement is obligatory after a full noun phrase, but with VS word order, singular agreement is used, and only gender agreement is obligatory (this is usually referred to as partial agreement) e.g.,

- (41) darasa Kariim al-'arabiiya  
 studied.M.SG Karim the-Arabic  
 'Karim studied Arabic'

(42) darasa kariim wa-widaad al-'arabiiya  
 studied.M.SG Karim and-Widaad the-Arabic  
 'Karim and Widad studied Arabic'

kariim wa-widaad darasaa al-'arabiiya  
 Karim and-Widaad studied.M.DU the-Arabic  
 'Karim and Widad studied Arabic'

In Example 42, as in 41, singular agreement is used, whereas in 42, the dual denotes two people. According to Moravcsik (1978), gender agreement is also optional with verb-subject order. Similarly in French, which shows gender agreement with a pre-verbal object (Example 40) but not with a post-verbal object (Example 43)

(43) j'-ai frappé-0 les filles  
 I-AUX hit.PPL-0 the.FPL girl.FPL  
 'I hit the girls'

As Moravcsik (1978) notes, however, it is impossible in this case to dissociate word order from pronoun versus full NP as the object obligatorily precedes the verb in the former case and follows it in the latter.

This phenomenon is also common with coordinated phrases, where the verb, rather than agreeing with the coordinated phrase (resolved agreement) agrees with just one of the conjuncts (partial agreement), e.g.,

(44) was the hat or the gloves on the table?

(45) the hat or the gloves were on the table

This will be discussed in detail in Chapter 5.

Agreement with verbs is varied in the languages of the world. Subjects may agree with verbs, objects may agree with verbs (this is mainly but not exclusively shown on participles), both or neither may agree. Verbal agreement may be conditioned by word order.

#### *Predicative adjectives*

Predicative adjectives agree with their subject, e.g.,

- (46) tist-i            fant        je        lep-0  
 this-DEF.M.SG boy.M.SG be.SG pretty.M.SG  
 'This boy is pretty'
- (47) tist-a            fant-a        sta        lep-a  
 these.M-DU boy.M-DU be.DU pretty.M-DU  
 'These boys are pretty'

Agreement differs according to position: gender (German) or definiteness (Slovene) may be shown in attributive position but not in predicate position (compare *lepi* in Example 33 with *lep* in Example 46). Predicative adjectives may show agreement or not, even in languages where adjectives otherwise do show agreement.

#### *Noun phrase predicates*

Predicative noun phrases agree with their subject, e.g.,

- (48) that girl acted like a cow / \*cows  
 (49) those girls acted like cows / \*a cow

The number of the noun phrase must agree with the subject just as any other predicate.

#### *Conclusion*

There are many different types of subject-predicate agreement: with verbs, predicative adjectives and noun phrases, as well as other contenders not discussed here such as possessives and anaphora of various types (pronouns and full noun phrases, deictic and non-deictic). I shall be concentrating on a particular subtype of the second type of agreement, subject-verb agreement.

### 1.5 Different types of agreement features

Agreement can be of three principal types: person, number, gender (or noun class). I shall concentrate on the latter two, since gender is inherent to the noun, number is, with some exceptions, inherent to the entity and its situation in the real world, whereas person alters according to conversational role (except, arguably, in sign languages, where it may be inherent); case usually excluded due to asymmetry and is not about the entity at all, but about the relation between the

entity and other entities in the sentence. Languages differ as to the amount of agreement they show. English is an analytic language (poor inflection). Slovene is synthetic - rich in inflection and derivation.

### 1.5.1 Number

Languages vary as to how rich their number systems are, and even more so as to how much of this richness emerges in their agreement systems.

*How many number values?*

English differentiates between singular and plural.

- (50) The boy was on the burning deck.
- (51) The boys were on the burning deck.

Some languages have several different number values, not just singular and plural. This is the case for Slovene, for Upper and Lower Sorbian (West Slavonic languages), and Arabic, among others. This example illustrates dual agreement in Modern Standard Arabic.

- (52) aTTaalib           jamiil  
the.student.SG beautiful.SG  
'The student is beautiful'
- (53) aTTaalib-aan jamiil-aan  
The               student-DU beautiful-DU  
'The two students are beautiful'
- (54) aTTulaab jamiil-uun  
The           student.PL beautiful-PL  
'The (more than two) students are beautiful'

Note that the existence of the dual slightly modifies the meaning of the plural in a particular language (i.e. unlike in English, the plural in MSA must refer to three or more entities) (Corbett, 2000). Other languages involve more complex systems, with four-way or even five-way systems (Corbett, 2000).

In conclusion, there are a range of number systems available, ranging from one number value<sup>10</sup> to four or five. The extent to which number agreement is flexible also varies between languages. Although Slovene is hardly exotic in its tripartite system, it is used in this thesis with the hope of extending the current knowledge, which has relied on bipartite number systems and the assumptions which follow from them.

*Extent of number agreement*

English differentiates between singular and plural, but the distinction cannot be made on the basis of the real-world entity in question. For instance, we can use a singular or a plural noun (with corresponding agreement, as shown in Examples 1.5.1 and 55) to refer to the same real-world entities (or group of entities):

(55) The luggage was there

(56) The suitcases were there.

These examples illustrate the seemingly arbitrary nature of the agreement which a particular lexical item may take. Similarly, languages may differ as to whether they would use singular or plural agreement for a particular entity, e.g., Slovene versus English ‘hair’ may be plural or singular,

(57) las-je so se zažgali  
hair-PL AUX.PL REFL set.alight-PL.M  
‘The hair has caught fire’

In Slovene, as in its English equivalent, the word *hlače* ‘trousers’ is inherently plural, otherwise known as *pluralia tantum*, whereas the equivalent French word, *pantalon*, is singular.

(58) The group was / were there

These two examples above highlight an interesting feature of English which differentiates British English from American English, namely that collective nouns may take singular or plural agreement in the former, whereas in the latter, plural agreement is often strongly dispreferred (Bock et al., 2006; Johansson, 1979).

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<sup>10</sup>It has also been claimed that a language, such as Pirahã, may lack any number whatsoever (Everett, 1983, 1986).

Johansson (1979) found that American students would correct plural agreement with collectives like *family, audience, committee, party, generation* to singular, whereas British students would not do so, but would sometimes correct singular agreement to plural. We will return to this point later.

Similarly, ‘potato’ may be a mass or count noun, depending on the language, as shown in the Slovene and its English translation, but it can also be a mass noun in English, as example,

- (59) dej mi še malo (pečen-ega) kromir-ja  
 give me more little roast.SG-GEN potato.SG-GEN  
 ‘Give me a few more (roast) potatoes!’
- (60) Give me a bit more (mashed) potato!

The dual may be limited, thus in Egyptian Arabic, it is optional; in some languages which have lost the full paradigm (e.g., Hebrew, Czech), the dual remains only for certain lexical items which come in pairs (e.g., arms, eyes).

### *Conclusion*

Within specific number systems, there is a great deal of variety, not only in how mass nouns and collective nouns agree, but there are other factors which condition agreement, such as animacy or certain lexical items, and there are even forms underspecified for number in some languages. The extent to which number agreement is flexible also varies from language to language.

There are many different number systems in the world’s languages, not just the singular-plural systems which are the domain of psycholinguistics. The singular / dual / plural combination is the most common system with three values and it is easily studied since it is used by over two million Slovene speakers in Europe, as well as speakers of Sorbian and Arabic. It also has an analogue in gender, since the three-way gender system is extremely common in Europe (it is used in German, Icelandic, Romanian, Greek, and most Slavic languages including Slovene).

#### 1.5.2 *Gender*

Gender agreement is common in the world’s languages, though gender is absent in Uralic languages (e.g., Finnish), Tagalog, and effectively in Chinese and

Japanese. Number of genders can vary from one (i.e. no gender differentiation) in the above languages to many, e.g., in the Bantu languages, where genders or classes (the term used especially when there are more than three genders) can reach fifteen.<sup>11</sup>

Corbett (1991) suggests that there are three different types of gender systems: semantic, morphological and phonological. These are not strictly delineated groups but gender systems seem to loosely equate more with one type than another.

### *Semantic*

English, Tamil, Lak and Dyirbal have a semantic system. In English, this is predominantly based on sex, although not entirely (e.g., unknown animals are often exceptions; see below). In Dyirbal, as described by Dixon (1972), agreement based on a combination of the semantics of the words (e.g., men, possums, fish, snakes, boomerangs are gender I; women and shields are gender II; honey and all edible fruit and vegetables are gender III; meat, parts of the body, grass, noises are gender IV) and associations - mythical (birds are thought of as the spirits of dead women so are in gender II), conceptual (fishing equipment is in gender I). Some languages (e.g., Archi, !Xũ) have systems which appear partially semantic.

### *Morphological*

The second type of gender system is morphological. These are defined on the basis of what agreement the members of each class take. Morphological systems are not unrelated to semantic systems: morphology is used when semantics fail and also morphology and semantics tend to overlap, thus a morphological system can be termed one where morphology accounts for more of the data than semantics alone. German, Latin, and Slavic and Bantu languages have a morphological gender agreement system.

Although in a language like German, there is some degree of semantic allocation to gender (e.g., *Vater* 'father' is masculine, *Mutter* 'mother' is feminine), a majority of the lexicon does not have it (e.g., *Mädchen* 'girl' is neuter, *Rübe* 'turnip' is feminine and *Regen* 'rain' masculine, though in French and Spanish, girls and rain are feminine whilst *navet* and *navo* 'turnip' is masculine, and in

<sup>11</sup>It is claimed (e.g., Kihm, 2002) that noun classes differ from genders (but see Corbett, 1991, for further discussion of this issue, which in any case need not concern us here).

Italian, the equivalent words are all feminine), such that Mark Twain (1880) in *A Tramp Abroad* writes of “the awful German language” and with “no sense or system in the distribution; so the gender of each must be learned separately and by heart”. In fact, in a morphological system, the classification is according to agreement, thus *Regen* is masculine because it takes the determiner *der* in the nominative, etc., whereas *Mädchen* takes *das* and *Rübe* *die*.

### *Phonological*

Corbett claims that there are also purely phonological systems include Qafar, Hausa, Yimas and French. French is a Romance language with two genders, in which gender is often thought to be divorced from phonology (unlike in Italian, say, where it is fairly predictable Chini, 1995; Tucker et al., 1977; Vigliocco and Hartsuiker, 2002). Even French phonology predicts gender assignment in the majority of its nouns, for instance nouns ending in /ɜ/ (e.g., *orange*) tend to be masculine whereas those ending in /z/ tend to be feminine (e.g., *braise*); nouns ending in /ɛzɔ̃/, /sjɔ̃/, /zjɔ̃/, /ɔ̃jɔ̃/, /tjɔ̃/ (e.g., *liaison*, *pression*, *télévision*, *légion*, *congestion*) are feminine whereas remaining nouns ending in /ɔ̃/ (e.g., *mouton*) are masculine.

### *Gender agreement exceptions*

Genders are not entirely straightforward. Many languages have some nouns of what Corbett (1991) calls inquiratorate gender, that is to say, some exceptions which take one gender agreement in the singular and another in the plural. Slovene has several such nouns, including ‘eye’<sup>12</sup>:

- (61) oko je            bolelo    punco  
 eye AUX.3.SG hurt.N.SG girl  
 ‘The girl’s eye hurt’
- (62) punca je            slepa    na obe            očesi  
 girl    AUX.3.SG blind.F on both.N.DU eye.DU  
 ‘The girl’s blind in both eyes’
- (63) oči    so            bolele    punco  
 eye.PL AUX.PL hurt.F.PL girl  
 ‘The girl’s eyes hurt’

<sup>12</sup>Neuter and feminine gender agreement do not actually differ in the dual, but *očesi* is generally taken to be neuter.

Other nouns may vary in gender even in the singular. The meaning may vary slightly but it is usually the case that the noun is one gender in a certain phrase or idiomatic expression (in existence prior to the noun changing gender) and another gender elsewhere, e.g. Slovene *pot* 'path, way' which is usually, but not always, feminine,

- (64) *božja pot*  
godly.F path  
'pilgrimage'
- (65) *božja pota*  
godly.N.PL paths  
'pilgrimages'
- (66) *križev pot*  
crucifixion.M path  
'the stations of the cross'

In French, adjectives following the noun *gens* 'people' are masculine in agreement whilst adjectives preceding it are feminine (Shelton, 1997), e.g.,

- (67) *les vieilles gens heureux*  
the old.F.PL people happy.M.PL  
'the happy old people'

English also allows for some variability. Though lacking grammatical gender, it does allow some gender agreement with non-biologically-determined nouns. Humans almost always have masculine and feminine pronoun agreement, but exceptionally, *it* may be used (especially pejoratively and for babies), and also, there is a long tradition of using *they* as a generic (epicene) singular (note that the verb is singular), e.g.,

- (68) Every body was punctual, every body in their best looks: not a tear, and hardly a long face to be seen (Austen, 1816)

Animals tend to be promoted to masculine or feminine agreement under approbation (such as the cat hero) and have neuter agreement otherwise; Baby is clearly lacking gender as yet, e.g.,

- (69) Then the Cat put out his paddy paw and patted the Baby on the cheek, and it cooed (Kipling, 1902)

In addition to human females and some female animals, some machines and vehicles (e.g., ships) may take feminine agreement.

For agreement, consistency is important: if the cat is *he* and the baby *it*, respective references to other genders later on would be likely to result in misunderstanding. Within the same utterance, as will be seen below, some degree of variance is permitted but only in one direction. One exception would be in the case of metonymy, which may result in inconsistency, e.g.,

(70) The volcano erupted when he / \*it entered the room

Another interesting exception to using the appropriate gender is when writing a formal report in Slovene of a meeting with only women in attendance. Whilst the biological gender of those attending the meeting may be female, the masculine form is preferred (Mojca Belak - personal communication), e.g.,

(71) odločili                   smo        se,    da ...  
 decide-PPL-M.PL AUX.1.PL REFL that ...  
 'We decided that ...'

### *Conclusion*

There are many different gender systems in the world's languages, not just the two-way (masculine-feminine or neuter-common) systems (found in Western European languages) that are the domain of psycholinguistics. Grammatical gender is more (often) non-semantically determined than number. Furthermore, within specific gender systems, there is a great deal of variation, not only where there is a discrepancy between biological (or semantic) gender and morphological gender, but there are other factors which condition gender agreement, such as animacy, and there are even forms underspecified for gender in some languages. As is the case for the number system, the Slovene gender system (feminine / masculine / neuter) is the most common system with three values and it is easily studied since it is used by over two million Slovene speakers in Europe, as well as being easily comparable to research in Greek, Romanian, Slavic and some Germanic languages which have the same system. Since Slovene has tripartite number and gender systems, this also makes it ideal for within-language comparisons of two different types of agreement.

1.5.3 *Person*

There are broadly three different persons in most languages including Slovene, first (*I, we* in English), second (*you* in English) and third (*he, she, it, they* in English). Third person is the least contentious, though it also occupies a present-day role as second person polite (honorific) form in languages such as present-day Spanish, to a (lexically) restricted extent in numerous other languages including French, e.g.,

- (72) *était votre majesté contente / content?*  
 was your.2 majesty.F happy.F / happy.M  
 Was your majesty happy?

and historically in Slovene<sup>13</sup>.

The third person is also the easiest to use in experimental conditions, since it is less discourse-dependent than the first- or second-person (for instance, the gender does not vary according to speaker as the designated entity tends to remain constant), so it is the form that has been chosen for more attentive study.

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<sup>13</sup>Slovene previously had three different forms according to the degree of respect necessary: *tikanje* 'calling someone *ti*' was used with one's familiars and *vikanje* 'calling someone *vi*' in more formal situations, but there was a third form, now extinct, *onikanje* 'calling someone *oni*' or 'calling someone *they*'. This exemplifies well the debate about the polite form of the second person: is it plural or singular? Interestingly, in Slovene, the dual overrides the use of *vi* (i.e. the plural form), thus showing respect to one person involves using the plural (or form identical to the plural) whereas with two people, the ordinary dual form is used. Discussing a similar phenomenon in Old Icelandic, Þráinsson (1979) suggested that the use of a plural form as a respectful form, as is common in a great many languages, was not coincidental but may have evolved from talking to important rulers who would have men to back or support them in battle and at court (whereas the ordinary people would not have an entourage). In many languages, polite / formal second person agreement involves optional (Slovene) or obligatory (French) mixed agreement with the predicate agreeing with either the number and gender of the subject (feminine singular) or with the formality (masculine plural), e.g.,

- (1) *ali ste bil-i srečn-i / bil-a srečn-a?*  
 Q AUX.2.PL be-M.PL happy-M.PL / be-F.SG happy-F.SG  
 'Were you happy?'



This is clear in the way that many neuter words for humans have come to be used with masculine or feminine (depending on the biological sex of the referent) agreement, e.g.,

- (75) dekle je priš-la  
 girl.N is come-PPL.F  
 'The girl has come'
- (76) zaspane je priš-el  
 sleepyhead.N is come-PPL.M  
 'The sleepyhead has come'

It must be said that neuter nouns in Slovene, especially in Ljubljansčina (the dialect spoken in Ljubljana), often take masculine agreement, even inanimate nouns, by way of the masculinisation of nouns (with or without the addition of a diminutive) e.g.,

- (77) okno je odprt-o  
 window.N is open-N  
 'The window is open'
- (78) oken je odprt-0  
 window.M is open-M  
 'The window is open'

### *Conclusion*

There is a great deal of variety outside the number - person - gender trio which is usually considered when discussing agreement. Animacy may impact on agreement, and the honorifics and classifiers certainly play a similar role, though whether or not they constitute agreement may be disputed.

The most universal types of agreement features are certainly person, number and gender. I shall be concentrating on the latter two, since they are easier to study in an experimental setting, and they vary in their inherent systems across European languages.

## 1.6 Different types of agreement: semantic versus morphological

Although many phenomena of agreement can be adequately described in purely formal terms, such as Slovene attributive adjective number and gender agreement with their head nouns, agreement does not merely correlate morphosyntactic properties of two given surface forms, but can also indicate semantic properties of their referents.

Semantic agreement is elsewhere called “ad sensum” (Corbett, 1991) or “pragmatic” (Pollard & Sag, 1994). Most languages have some degree of semantic agreement, but they tend to also have syntactic or formal agreement. As mentioned above, whilst gender is intrinsic to an entity, number is often dependent on a particular discourse, thus number is more semantic than gender.

### 1.6.1 Morphological

Morphological or purely syntactic agreement is where the agreement is not overridden by the semantics, such as collectives with singular agreement, grammatical gender winning out over biological gender, e.g.,

- (79) The group was on the burning deck  
 (80) dek-le je priš-lo  
 girl.NEUT AUX came-NEUT  
 ‘The girl came’

Morphological agreement is generally seen as normal agreement, with semantic agreement being an aberration. It is therefore upon the latter that I shall concentrate.

### 1.6.2 Semantic

Semantic agreement is where the grammatical attributes of the controller are overridden by its semantics, for instance grammatically singular collectives may have plural agreement (especially in British English), grammatically neuter nouns may show biological gender agreement (in Slovene), e.g.,

- (81) The group were there

- (82) dekle je priš-la  
 girl.NEUT AUX came-FEM  
 'The girl came'

Languages vary as to how and where semantics may dictate agreement.

- (83) The data ?was / were in the file.

This example illustrates the seemingly arbitrary nature of the agreement which a particular lexical item may take; whilst *data* may refer to the same real-world entities (or group of entities), it can control different number agreement: collective nouns may take singular or plural agreement according (at least partly) on to what extent the individual entities with a group are seen as individual and to what extent they are seen as a unified whole.

#### *The Agreement Hierarchy*

The Agreement Hierarchy, proposed by Corbett (1979), was formulated to describe the possibility and relative frequency of semantic agreement compared to purely syntactic agreement. Corbett claims that syntactic distance is correlated with the likelihood of semantic agreement. He proposes that four different types of targets: attributive modifiers, predicates, relative pronouns and personal pronouns are ordered in a hierarchy of positions according to the likelihood of semantic agreement with controllers that permit alternative agreement forms thus:

- attributive → predicate → relative pronoun → personal pronoun.

The hierarchy predicts that semantic agreement occurs most frequently in personal pronoun targets (and when it does not do so, it likewise does not occur in the other three types of agreement target), whereas the likelihood of semantic agreement in an attributive target is very low (and only possible where it is also possible in the other three types of target).

Comrie (1975), followed by Corbett (1998), has suggested that there is also a predicate hierarchy:

- verb → participle → adjective → noun.

The hierarchy predicts that semantic agreement occurs most frequently at the right-hand side of the group.

*Conclusion*

Semantic agreement is clearly dependent on a number of factors - lexical semantics of the controller, discourse factors including real world knowledge, and the identity of the target.

Gender agreement in a language can be more or less semantic, and this is also true of number agreement and even person agreement. The Agreement Hierarchy shows to some extent under what conditions semantic agreement occurs compared to purely syntactic (morphological) agreement.

## 1.7 Agreement processing - what influences agreement?

An important question in language production is whether elements, such as syntax, semantics, and phonology, are isolated, or whether they can interact with each other during processing. Agreement is commonly seen as a syntactic process, thus agreement processing can be used to investigate this question. Chomsky (1965, 1981) regarded agreement, and indeed all inflectional morphology, as part of the syntactic structure. The most important debate in agreement processing is whether only syntax is involved or whether it is susceptible to other influences. In some modular frameworks (Garrett, 1980; Levelt et al., 1999), information is assumed to flow in one direction from top to bottom. Thus, a syntactic operation like subject-verb agreement between a controller (e.g., the subject) and a target (e.g., the verb) is assumed to be guided by the lexicosyntactic features of the subject lemma, but not by its phonological properties at the lexeme level or by semantics. In contrast, in models taking an interactive approach (Dell, 1986; Vigliocco and Hartsuiker, 2002), though the components involved in sentence production are similar, their interaction is bidirectional. This allows morphological and even phonological influences on syntactic processes like agreement, and also greater interaction between semantics and syntax during agreement processing. Investigation of agreement processing thus enables a direct comparison of top-down views of language production with interactive models.

### 1.7.1 *Attraction errors*

Like other kinds of speech errors, variation in agreement (including agreement errors) illuminates how normal language production works (Dell, 1986; Fromkin, 1971; Garrett, 1975; Stemberger, 1985). Attraction errors, where speakers make a

verb agree with an intervening ('local') noun rather than with the subject head noun, are well established with plural local nouns; sentences like

(84) The readiness of our conventional forces are at an all-time low

are well-attested (Strang, 1966). In this sentence, the subject (*readiness*) is singular, yet the verb (*are*) is plural, apparently due to the intervening local plural noun (*forces*), which is said to be acting as an attractor. This kind of agreement is generally referred to as involving an "attraction error" (Zandvoort, 1961) or "proximity concord" (Quirk et al., 1972); it is warned against in prescriptive grammars (e.g., Quirk et al., 1972). I shall continue to refer to such variation in agreement as errors, whilst recognising that there may be varying degrees of acceptability amongst speakers (see Francis, 1986, for a defense). Plural attraction errors with a singular head (subject) noun, as in Example 84, are much more common than singular attraction errors with a plural head noun. Strang (1966) reported 38 out of 46 attraction errors to be of this type in her corpus of English examination papers. Bock and Miller (1991); Follett (1966); Zandvoort (1961) reported similar proportions of errors in separate corpora. This asymmetry must be explained in any account of agreement processing. Conversely, in a study of spontaneous errors, Stemberger (1985) reported a strong asymmetry in adult English speakers, with more errors of producing singular verbs than plural verbs. This effect has subsequently been attributed to markedness (Eberhard, 1997), which will be discussed in detail in Chapter 2.

Different patterns of agreement and the production of attraction errors may be used in order to examine such questions as whether language production is unidirectional and modular or bidirectional or nonmodular.

### 1.7.2 Models of agreement processing

#### *Agreement processing in a non-interactive system*

As observed above (Section 1.2), Bock and Levelt (1994) propose that grammatical encoding involves two levels of representation, namely the functional level and the positional level. They propose that agreement processing occurs within functional processing, with a "dependency" only created between noun and verb if their features do not clash. When a lemma is selected, the information about what morphemes it can be used with is present, such as whether it requires a

regular or irregular plural marker, or its gender. These specifications are said to be directly incorporable into a structural frame (Bock & Levelt, 1994). Bock & Levelt (1994) also claim that when the specifications are not part of the message, or have already been specified, as they argue is the case for agreement, the redundant re-specification information comes from the lemma. For instance, the following sentence redundantly provides singular feminine morphemes on five different elements, e.g.,

- (85) deklica je bila prijetna do mene in me  
 girl.F.SG AUX.SG be.PPL.F.SG friendly.F.SG towards me and me  
 je imela rada  
 AUX.SG have.PPL.F.SG like.F.SG  
 'The girl was nice to me and liked me'

(Note that in the English gloss, there is likewise redundancy, since the word *girl* and the word *was* are both clearly singular.) Bock & Levelt (1994) claim that agreement is specified by the lemma of the noun (e.g., *deklica* 'girl' is feminine) and is inherited by agreeing elements (e.g., *bila* 'was', *prijetna* 'friendly', and that this occurs at the level of functional processing. They indicate that the message, the verb or the subject could be the locus of the feature(s), but that the subject is most likely the controller and the verb the target. Clearly, this leaves open the possibility of different parts of the subject (head noun, local noun) playing different roles, but at the functional level, morphophonological and semantic influences (outwith the message) are not possible.

Bock, Eberhard and colleagues (Bock, 2004; Bock et al., 2001; Eberhard et al., 2005) have developed a feed-forward model of agreement production which they call Meaning, Marking and Morphing (MMM). The original aim of this model was to explain the differences between agreement with pronouns and verbs: although number meanings are the same for pronouns and verbs, the two differ in the transition from meaning to syntax. On this account, agreement production consists of two processes, "marking", which allocates the entire noun phrase an abstract number (or gender, or person, or any other agreement) value; and "morphing", which implements grammatical agreement, with the agreement controller specifying the form of its number or gender on a particular target (e.g., a verb). Marking, it is claimed, can refer to semantics, but morphing is a process which only has access to syntactic information. Whilst marking can refer to any available information (including semantics), morphing is blind to other influences and only refers to syntax. Number specification of a complex NP is

calculated in working memory by a spreading activation process. Number is represented as a continuously-valued feature, positive for plural NPs and zero for singular NPs, calculated according to lexical constituents including the head and local nouns. Crucially, although the semantics of any element within the subject NP including the local noun may influence the initial marking process, once it has been assigned an SAP, no semantics including the local noun's semantics can influence the morphing process. Correct agreement is produced by transfer of the number of the subject NP controller to the target, but incorrect agreement may occur through transmission of the local noun's number to the target instead. Empirical evidence in support this model will be provided in Section 1.7.3. More detailed discussions of the model are to be found as the relevant issues arise in Chapters 2 and 3.

#### *Agreement processing in an interactive system*

Hartsuiker et al. (2003) point out that there are several different possible accounts of morphophonological effects, more specifically the effects of ambiguity of determiner on attraction errors, whereby ambiguous determiners lead to more errors than non-ambiguous ones. They propose (compatible with Dell, 1986; Stemberger, 1985), if information can feed forwards and backwards, ambiguity in word forms may lead to incorrect feature codes (e.g., the wrong gender being assigned), thus agreement errors may be caused by computation at an early stage.

If a feed-forward system of language production is assumed (Levelt, 1983, 1989), a self-monitor can still catch some syntactic errors, perhaps more-so in the case of unambiguous forms (Hartsuiker et al., 2003) or those with no semantic incompatibility, thus agreement errors may be influenced by morphophonology or semantics. Other accounts based on unification (Alario and Caramazza, 2002; Bock et al., 2001; Lapointe and Dell, 1989) assume that agreement errors occur when morphemes are integrated into the structural frames of phrases.

Dell (1986) proposes that the syntactic frame is built on the basis of semantic representation and activated word nodes. In terms of agreement with a noun phrase, the appropriate affix (e.g., plural *-s*) and the noun are both activated, and a syntactic frame is built with a position for the suffix. However, if the timing is not simultaneous, the wrong noun may be slotted into the frame with a suffix slot, thus accounting for shift errors of the type shown in Example 86.

(86) We were in Dallas for the Ram games (Garrett, 1980)

for ... *for the Rams game*.

This kind of error is clearly analogous to agreement errors, where the incorrect agreement morpheme is added to the verb (rather than to a noun). The process cannot be exactly the same, however, since in shift errors, the already phonologically specified affix is shifted (e.g., the singular *-s* in Example 27, whereas in agreement, it is the plural feature (which may be *-s*) which is realised on the verb.

Vigliocco and colleagues Vigliocco et al. (1996a, 1995) propose a unification model of agreement based on the Incremental Procedural Grammar of Kempen and Hoenkamp (1987). As lemmas become available, syntactic constituents (roughly) are sent to the phonological encoder as they are generated, thus grammatical encoding is incremental, as well as being lexically driven. Agreement would work in three stages or procedures. First, the conceptual representation (including a noun's number value, count status, syntactic category, etc.) is accessed. Then the elements within the NP (e.g., determiner and noun) are marked for these conceptual values. Similarly, the verb also accesses features (including number, person) directly from the conceptual representation. Thirdly, the functional destination is assigned to the NP (e.g., subject, NP post-modifier). Finally, the features (e.g., plural, third person) are assigned to the highest NP projection. Once the subject and predicate are both identified, their values can be unified. Vigliocco and Nicol (1998) claim that agreement processing occurs during grammatical encoding "when a hierarchical frame for the to-be-uttered sentence is generated", prior to linearisation. On their account, attraction errors are caused by incorrect unification of the verb with the local instead of the head noun. There is no encapsulation, but the more embedded an element is, the less likely it is to have an effect on the final agreement of the target, because it has a greater syntactic distance to travel (Vigliocco and Franck, 1999). Vigliocco and Franck (1999) contrast what they call the minimal and the maximal input hypotheses. As mentioned above the type of input which the encoder receives from conceptual structure may be minimal, in the sense that it is restricted to being used in order to establish the agreement controller's syntactic features and then discarded, whereas according to the maximal input hypothesis, agreement processing may make use of semantic features for other purposes. Vigliocco and Franck (2001) further stipulate that the syntactic and semantic information available for agreement processing is not of equal status, with the former termed primary and the latter secondary.

Vigliocco and Hartsuiker (2002) find support for a model with multiple levels of integration (for production) but that is not strictly encapsulated. Vigliocco and Hartsuiker (2002) propose maximal input, with weights for different types of information, and a bidirectional flow of information. Thus there is some degree of built-in redundancy but there are alternative sources of information in case one source fails or prior to that source becoming integrated and thus available. They propose that, for example, although the usual order would be first lexical retrieval and then phrasal integration, these two might occur in the opposite order, thus resulting in agreement errors.

Franck et al. (2006) have more recently further refined these ideas to incorporate (Chomsky, 1995) latest ideas from the Principles and Parameters / Minimalist Programme. Crucially, they assume the existence of an additional level of representation between the functional level and the positional level, and they also propose that the agreement process consists of two processes equating to Chomsky's AGREE relation and the checking process.

In the Competition Model (Bates and MacWhinney, 1989), there are two levels of information structure, the functional level (equivalent to Levelt's message level) and the form level (output). Their aim is to have a simple mapping between the two levels. The model depends on cues such as word order, agreement, animacy. Cue validity refers to how reliable and available a cue is, whereas cue cost refers to processing limitations. (Bates and MacWhinney, 1989) claim that different languages rely more on different cues, so that speakers of English rely more on word order whereas speakers of morphologically rich languages rely more on agreement (MacWhinney et al., 1984). This model is designed to account for comprehension data, but it is interesting because it provides inspiration for Hupet, Fayol and colleagues' agreement production model. Fayol et al. (1994) claim that whilst writers have both declarative and procedural knowledge of French agreement, the fact that they make mistakes suggests that "the difficulty consists more probably in the on-line management of the agreement". Fayol and colleagues (Hupet et al., 1996; Fayol et al., 1994, 2007) propose a two-stage process. First, the verb's number value is automatically activated from the number of the nearest noun. Clearly, this may result in agreement errors, therefore there is a second (nonautomatic) checking mechanism which is analogous to the process of prearticulatory checking (Levelt, 1983, 1989), and is only necessary when the two nouns differ in features but have the same form. This approach implies that linear proximity in the sentence is important, therefore agreement processing

would take place after word order had been established. Of course, it is not necessarily the case that a model of written agreement production (in fact, spelling) can be generalised to spoken agreement.

Another proposal which predicts the influence of nonsyntactic factors in agreement processing is the constraint-satisfaction model (e.g., MacDonald et al., 1994; Tanenhaus et al., 1995). Although these models were designed with sentence comprehension in mind, they also make predictions regarding production. Bates and MacWhinney (1989) propose a model of language production and acquisition which expressly aims to be universal rather than English-specific. The competition model directly maps form onto function. The model involves a trade-off between cue cost (e.g., cognitive load, articulatory complexity) and cue validity (the value of the phonological, morphological, or syntactic information provided by the respective form) (Bates et al., 2001). Cue validity varies cross-linguistically, with subject-verb agreement being a strong cue to agent-object relations in languages with a rich morphological agreement system, and a weaker cue in a language like English.

Hartsuiker and Barkhuysen (2006), following others (Vigliocco and Nicol, 1998; Eberhard, 1997; Franck et al., 2002; Vigliocco et al., 1996a; Bock and Cutting, 1992; Hartsuiker et al., 2001), propose a race model where there are two contenders for agreement controller. They claim that “the verification process specifically targets the level of syntactic integration and not the mapping of number features from the conceptual to the functional level.”

### *Conclusion*

Clearly, there is still a great deal of debate about the advantages of various models of agreement processing. Most of them share certain assumptions. According to what is perhaps the best-known explanation of this sort, errors arise when the number feature on the local noun

Below the evidence for various features will be discussed in more detail.

#### *1.7.3 Evidence that syntax is isolated*

Bock & Miller (1991) introduced a methodology for investigating agreement processing by eliciting attraction errors. Bock & Miller (1991) presented experimental participants with a sentence fragment like one of the following

(87) The key to the cabinet

(88) The key to the cabinets

The task was to repeat the preamble and to complete it; thus participants would be expected to produce a response like

(89) The key to the cabinet(s) was rusty

but in a few cases, when the local noun (*cabinets*) was plural, they would produce erroneous plural subject-verb agreement, e.g.,

(90) The key to the cabinets were rusty

Note that in the psycholinguistic experimental literature from Bock & Miller (1991) onwards, attraction errors are defined in terms of a baseline of errors produced in the match condition (assumed to be random errors, since they do not agree with the head or the local noun), and from henceforth, so will this thesis.

The main evidence for agreement processing being purely syntactic comes from early null results in English experiments, which suggested that syntax alone controlled agreement. Bock & Miller (1991) presented participants with (auditory) preambles which varied as to whether the head noun was singular or plural and as to whether the local noun was singular or plural e.g.,

(91) The key to the (ornate Victorian) cabinet

(92) The key to the (ornate Victorian) cabinets

(93) The keys to the (ornate Victorian) cabinet

(94) The keys to the (ornate Victorian) cabinets

They found that there were more plural completions after a plural local noun than after a singular local noun. As in naturally occurring speech, they found that there was no such difference between the singular errors produced after a singular local noun and a plural local noun. Thus, attraction errors were shown to be a replicable phenomenon with this methodology, but singular heads and not plural ones were susceptible to errors. Bock & Miller (1991) ruled out “simple frequency effects” (i.e. choice of most frequent form) on the grounds that the least frequent form (*were*) was chosen over its more frequent counterpart (*was*).

They also ruled out a memory-based explanation on the grounds that it would not differentiate between different number values (and thus cause the singular - plural asymmetry). They also ruled out an explanation in terms of dialectal variation, since participants' grammaticality judgements were not correlated with their performance in the sentence completion task. They examined a phonological explanation (Stemberger & MacWhinney, 1986), which suggested that the pervasiveness of plural errors might be due to some kind of "affix checking" whereby the processor (either using a common morphophonological specification for marking number on both nouns and verbs or not), having found a plural /s/ (albeit on the local, not the head, noun), would be inhibited from producing a singular /s/ (this hypothesis is examined in Bock & Eberhard, 1993, discussed below).

Length (the inclusion, or not, of modifiers like *ornate Victorian*) made no difference either. However, in 27 of the 32 experimental items, within the material making up the length, there were other singular distractor nouns, e.g., *Victorian* (Example 92), *medicine* (Example 95), *garter* (Example 96) and *battalion* (Example 97) are all nouns.

- (95) The label on the tamper-proof medicine bottles
- (96) The boy that liked the colorful garter snakes
- (97) The soldier that the battalion's senior officers accused

Considering the later work of Franck et al. (2002, described below), it may be that the number of errors was reduced by the intervening singular noun, and otherwise would have been increased by length alone. Bock & Miller (1991) concluded that distance between the head noun and the verb was of little importance, suggesting that agreement is produced before the stage at which word order is specified.

As mentioned above (Section 1.5.4), animate entities are more likely to be placed in subject position than inanimate entities (McDonald et al., 1993). Bock & Miller (1991) also tested whether animacy, concreteness and distributivity had an effect on the rates of subject-verb agreement errors, comparing preambles like

- (98) The author of the speeches
- (99) The speech of the authors
- (100) The mountain of the nomads

- (101) The nomad of the mountains
- (102) The label on the bottles
- (103) The bridge to the islands

in order to test whether semantics of the individual nouns had any effect on agreement, or whether agreement was produced independently of semantics. They found a significant main effect of animacy (uninflected verbs being more common after inanimate local nouns), but since this was uniformly the case whether or not head and local nouns matched or mismatched in number, and there was a singular-plural asymmetry for both kinds of local nouns, they concluded that animacy had no effect on agreement. More specifically, they found that the animacy of the local noun did not affect agreement. (Reybroeck et al., 2005; Barker et al., 2000, discussed in detail below) also failed to find a correlation between the plausibility with which head and local noun could serve as the subject of the sentence and attraction error rates. Bock & Miller (1991) also compared concreteness of the local noun; for example, *speeches* is abstract in the above examples but *mountains* concrete, but found no consistent differences. Finally, they contrasted sentence fragments likely to receive a distributive interpretation (e.g., 102, where there are clearly several bottles each with its own label token) with items that are not (e.g., 103, where there is one bridge giving access to several islands). Again, they failed to find consistent effects, leading them to conclude that agreement was produced independently of semantics.

Bock & Eberhard (1993) employed the same methodology to investigate whether it was the phonology of the plural (i.e. the /s/ itself) which caused the asymmetry between singular and plural agreement errors. Participants were presented with written preambles like

- (104) The gardener with the hoe
- (105) The gardener with the hoes
- (106) The gardener with the hose

where the plural was homophonous with another singular word. If the phonology was important, then there should have been no difference between the plural (e.g., *hoes*) and the singular homophone (e.g., *hose*), but instead, Bock & Eberhard found that the singular homophone (e.g., *hose*) did not differ from the baseline (e.g., *hoe*). This (null) finding provided support for a phonology-free process

of agreement. Bock & Eberhard (1993) also found no difference between patterns of errors following irregular and regular plurals, e.g.,

(107) The trap for the rats / mice

This suggests that agreement is produced independently of morphophonology.

Eberhard (1997) proposed that the reason for the asymmetry between singular and plural attraction errors detailed above was due to the fact that the singular was unmarked (i.e. had a zero morphophonological feature) whereas the plural was marked (i.e. had an overtly-realised morphophonological feature, usually /s/). This is an explanation for why the singular does not cause attraction errors (there is no singular feature marker to be erroneously attached to the verb) and also why the singular is more susceptible to attraction errors (there is no singular feature marker to compete with the plural feature marker). In order to test this hypothesis, Eberhard asked participants to complete preambles which either contained an extra number marker (e.g., *one*, *several*), or contained no such extra marker, e.g.,

(108) The key to the cabinets

(109) One key to the cabinets

She found that there were fewer attraction errors in the case of the head nouns overtly as well as inherently marked for singular, thus providing support for her claim that singulars are inherently unmarked. In order to rule out the suggestion that the singular in English is not unmarked but is merely less marked (with the extra marker *one* merely adding to the markedness), Eberhard also compared additional plural markers. Participants were asked to complete preambles which either contained an extra number marker (e.g., *one*, *several*), or contained no such extra marker, e.g.,

(110) The key to the cabinets

(111) The key to several cabinets

(112) The keys to the cabinet

(113) The keys to one cabinet

Eberhard (1997) found that although the extra plural number marker had no significant effect on the plural attraction error rate, the extra singular marker did

have an effect on the rate, suggesting that the singular is indeed unmarked and the plural marked.

Bock & Eberhard (1993) investigated the role of collective nouns in agreement production. They had participants complete sentence fragments with either singular non-collective, plural non-collective, singular collective or plural collective local nouns, e.g.,

(114) The condition of the ship(s)

(115) The condition of the fleet(s)

Participants were found to produce plural verbal agreement only when the local noun was plural in the case of both collective and non-collective nouns (i.e. there were no errors with singular collectives, e.g., *fleet*); thus Bock & Eberhard concluded that there was no effect of collectivity (although it is perhaps worth noting that there were more plural errors with the plural collectives (e.g., *fleets*) than with the plural non-collectives (e.g., *ships*); this is noteworthy, since it runs counter to Eberhard's (1997) claim that plurality marking cannot be enhanced, but is binary).

Further evidence of syntactic influences come from Bock & Cutting (1992) and later Nicol (1995), who found that a local noun in the same clause as the head noun can interfere more with the agreement process than when it is situated in a separate clause. They compared clausal post-modifiers and phrasal post-modifiers, e.g.,

(116) The editor(s) of the history book(s)

(117) The editor(s) who rejected the book(s)

The main findings were that clausal post-modifiers yielded fewer errors than phrasal post-modifiers. These results suggest that clausal constituency insulates noun phrases to some extent from interactions with verbs outside their clause. The insulation is far from complete, however, since there was a (weaker) effect of attraction from clausal post-modifiers. There could be other explanations but any explanation is syntactic. Vigliocco & Nicol (1998), for example, suggest that it is syntactic proximity (to the head) rather than linear proximity (to the verb) of the local noun which is crucial.

Vigliocco & Nicol (1998) found that linear proximity had no effect on agreement, since “The helicopter for the flights” produced similar attraction errors when participants were asked to produce interrogatives, e.g.,

(118) Is the helicopter for the flights safe?

or declaratives, e.g.,

(119) The helicopter for the flights is safe

This suggests that linear proximity is not a necessary condition for attraction (see also Pearlmutter, 2000, for similar findings in sentence comprehension), again suggesting a model in which agreement is purely syntactic and the results are compatible with a model in which agreement occurs before word order is specified (including models in which the structure of the two sentences is the same prior to movement - e.g., Chomsky, 1957). Vigliocco and Nicol (1998) propose that the errors are caused by percolation up the syntactic hierarchy from the local noun to the subject NP.

Similarly, Timmermans et al. (2004) failed to find an effect of linear proximity in the production of agreement. They gave participants preambles including one second person conjunct and one third person conjunct (e.g., Example 120 and 121).

(120) jij en de jongen  
you.SG and the boy.SG  
'you and the boy'

(121) de jongen en jij  
the boy.SG and you.SG  
'the boy and you'

They found that both Dutch and German participants had a tendency to produce third person plural agreement instead of second person plural agreement which is usually deemed to be correct, but, crucially, that this agreement was not affected by linear proximity.

Hemforth and Konieczny (2003) examined agreement in written German to investigate whether it was influenced by linear order. The results were mixed and

some will be discussed later. They presented participants with preambles involving two nouns within a subordinate clause. The two nouns either matched or mismatched in number (matching conditions are shown in Examples 122 - 123 with correct agreement).

- (122) Ich habe gehört, dass der Mann die Frau besucht hat  
 I have heard that the man the woman visited AUX.SG  
 'I have heard that the man has visited the woman'
- (123) Ich habe gehört, dass die Männer die Frauen besucht haben  
 I have heard that the man the woman visited AUX.PL  
 'I have heard that the men have visited the women'

Hemforth and Konieczny (2003) argued that if linear proximity influenced agreement, then there should be object agreement after a singular subject followed by a plural object. However, this argument is based on the commonly- (but not universally-)found asymmetry between plural and singular errors. Furthermore, others (e.g., Hartsuiker et al., 2001) have found object attraction, thus whilst these kind of errors are not as common as other types of errors, they do exist.

They failed to find linear effects in object attraction. It should be noted they did not find that a proximity-based account could explain any of their data other than the disjunctives, and therefore did not suggest that their results support a proximity account over a percolation-based one, except in the case where syntactic constraints are weak.

### *Conclusion*

Against the traditional view of linear proximity, there has been considerable evidence brought forward in favour of a predominantly syntactic explanation of agreement processing, either in terms of clause encapsulation or in terms of markedness, or indeed in terms of feature percolation in the syntactic hierarchy. However, recently, evidence of non-syntactic forces has also been produced, as we shall now see.

#### *1.7.4 Evidence for an interaction with semantics*

The first source of evidence comes from semantic influences in attraction error production.

*Biological gender*

Vigliocco & Franck (1999) investigated whether semantics affect agreement in gender, namely, does biological gender (sex of the referent) provide a stronger cue than mere grammatical gender in grammatical gender languages like Italian or French? If so, then there is an effect of semantics on agreement processing and thus agreement must either be processed after semantics (consistent with Cubelli et al., 2005) or there must be some accessibility to semantics in agreement production. Participants were presented with a noun (grammatically masculine or feminine, and either with matching conceptual (biological) gender, e.g., *sposo*, 'groom', or without, e.g., *cero* 'candle') postmodified by a prepositional phrase including another noun (masculine or feminine; gender always mismatched with the gender of the head noun), e.g.,

- (124) lo sposo in chiesa  
 the.M groom.M in church.F  
 'The groom in the church'
- (125) la bidella nell' atrio  
 the.F janitor.F in hall.M  
 'The janitor in the hall'
- (126) il cero in chiesa  
 the.M candle.M in church.F  
 'The candle in the church'
- (127) la lampada nell' atrio.M  
 the.F lamp.F in hall.M  
 'The lamp in the hall'

Vigliocco & Franck found that agreement errors were more common for the latter type of head nouns (i.e. those with grammatical gender only) than for those which also had conceptual gender. However, one possible explanation for these results is that the head nouns with semantic as well as grammatical gender were (more) animate and therefore if one assumes a head misselection explanation (Bates & MacWhinney, 1989), the inanimate nouns would be less likely to be selected as subjects, thus the latter type of preambles would be more likely to be susceptible than the former because of animacy not merely semantic gender. An animacy explanation was ruled out in further experiments comparing inanimate to animate materials without biological gender (names for animals such as *ghepardo* 'leopard' which refers to both the male and the female of the respective

species) in Italian, and comparing animals with conceptual and biological gender such as *manège* ‘mare’ and those with only grammatical gender such as *méduse* ‘jellyfish’ in French. The effects were still present although all head nouns were animate, although clearly animacy was not kept constant, as some animals (e.g., horses) may be perceived as more animate than others (e.g., jellyfish).

Vigliocco and Zilli (1999) investigated whether conceptual information affected agreement production in patients with Broca’s aphasia and those with no deficit. They replicated Vigliocco & Franck’s (1999) results; animacy effects were also ruled out.

Vigliocco & Franck (2001) investigated the effects of biological gender on agreement in French and Italian, namely whether a feminine noun such as *la vittima* is more likely to be followed by masculine agreement when preceded by a context introducing a male than a female victim. They presented participants with a context including a male or female referent, e.g.,

(128) un camion a investito Fabio / Fabiola che correva in bicicletta

ascoltando musica

‘A lorry hit Fabio / Fabiola who was riding a bike whilst listening to music’

and then asked them to complete a preamble such as the following:

(129) la vittima dello scontro

‘The victim of the accident’

where the head noun is grammatically feminine but can refer to a man or a woman, and a local attractor noun which is masculine. Finally, the participants were presented with a gendered adjective to employ in their completion (e.g., *distratto / distratta* - ‘distracted’). They found more attraction errors when the biological gender of the referent of the head noun matched that of the attractor (e.g., more masculine errors for *Fabio* than *Fabiola*). Clearly, the grammatical gender of the head noun (e.g., *vittima*) does not vary, thus the results show that the conceptual properties of the subject head noun can affect agreement regardless of grammatical properties.

However, Antón-Méndez et al. (2002) likewise failed to find any difference between nouns which had pure grammatical gender and those which also had congruent semantic gender. This suggests that the findings are more subtle than merely that errors are more likely with one type of noun than another.

Slevc et al. (2007) investigated whether semantics affect agreement in gender by investigating attraction errors caused by notional gender. Participants were presented with pictures which they had to describe, and targets were such as 130 or 131. The pictures showed the gender of the referent (e.g., *cousin* was paired with a stick figure wearing a skirt or one with a moustache). The gender of the goal argument was either part of word knowledge (e.g., *granddaughter*) or part of world knowledge (e.g., *cousin*). Slevc et al. (2007) found more genitive pronouns with incorrect gender after a mismatching pair (e.g., *Victor / granddaughter*) than after a matching pair (e.g., *Victoria / granddaughter*). Importantly, this was equally true when the gender of the attractor was part of word knowledge and world knowledge (e.g., *granddaughter* pictured wearing a skirt) and when the gender was not part of word knowledge but only part of world knowledge (e.g., *cousin* in a skirt).

(130) Victor / Victoria carried a package to his / her granddaughter

(131) Joanne / Jim provided money to her / his cousin

Slevc et al. (2007)'s results show that attraction errors in notional gender agreement are clearly semantic, which is problematic for any model which assumes the attraction process to be syntactic.

### *Imageability*

Contrary to the usual singular-plural asymmetry found in studies of attraction errors, Haskell and Bock (2003) found evidence of a larger singular than plural attraction effect where the task was more naturalistic and the entities in question were not merely imageable but were actually visible (thus there was not the usual ambiguity of mappings). Often, the singular-plural asymmetry is explained in terms of the additional complexity of the plurals. Arguably, a naturalistic task with a clear number of plural referents rather than the potentially infinite number available in similar purely verbal tasks simplifies the plural referents in both head and local position, thus putting the singular nouns more in competition with the plurals.

Eberhard (1999) also found that the distributivity effects were correlated with imageability ratings, suggesting that there were more errors in the distributive phrases because they were easier to imagine. The fact that more and not fewer errors are found the more imageable the preambles were is not compatible with the theory of head misselection (Bates and MacWhinney, 1989; Fayol et al., 1994).

In a similar vein, Solomon and Pearlmutter (2004) tested the effect of semantic integration on attraction error rates. They found that participants presented with fragments were more likely to make errors when the noun phrases were integrated, i.e. when the head noun's meaning is dependent on the post-modifier (Example 132) compared to when they were not as integrated, i.e. the post-modifier seems to merely provide additional information (e.g., 133).

(132) The drawing of the flowers

(133) The drawing with the flowers

This suggests that the degree of integration of nouns within a phrase influences planning: more tightly integrated elements (such as Example 132) tend to be planned together, and thus properties of such elements, such as number, have a greater chance of interfering with each other, compared to less tightly integrated elements (such as Example 133). Similarly, Bock et al. (2001) found twice as many errors when participants were not presented with pictures depicting the subject preamble to when they were, suggesting that imageability may well be a factor in attraction error production.

### *Animacy*

Vigliocco and Zilli (1999) ruled out their grammatical versus biological gender effects being due to animacy, but is there an effect of animacy on agreement processing nonetheless?

Bock & Miller found that the animacy of the local noun did not affect agreement. However, Barker et al. (2000) found that animacy had a reliable effect on error rates in both head and local noun position. They compared animate and inanimate head noun and animate and inanimate local noun, e.g.,

(134) The girl behind the teacher(s)

(135) The girl behind the desk(s)

- (136) The blackboard behind the teacher(s)  
 (137) The blackboard behind the desk(s)

The animacy of the local noun (attractor) did not affect results alone: animate attractors do not cause more errors than inanimate attractors. However, an animate head noun is less susceptible to agreement errors, and there is an effect of whether the animacy of the head and local noun matched or mismatched. The inanimate head and local noun number mismatch condition led to the most errors, which Barker et al. explain in terms of semantic relatedness. The fact that the similarity of the two nouns leads to more errors is compatible with the theory of head misselection (Bates and MacWhinney, 1989; Fayol et al., 1994). Alternatively, it could be that there is increased activation of the local noun due to the semantic overlap without predicting head misselection (Pittman and Smyth, 2007).

### *Plausibility*

Thornton and MacDonald (2003) showed a larger attraction effect if the local NP is a plausible subject for the verb. They presented participants with sentence fragments like

- (138) The album by the classical composers

where the key words with which the participants were instructed to make the completions varied as to whether they were compatible with both head and local noun (e.g., both *albums* and *composers* can be *praised*) or only with the head noun (e.g., only *albums* and not *composers* can be *played*). They found that there were both higher attraction error rates in production and longer reaction times at the verb in comprehension when both nouns were plausible subjects (e.g., *praised*) as opposed to when only the head noun was a plausible subject (e.g., *played*). Hupet et al. (1998) also found that plausibility affected agreement error rates. In a dictation task, they found that sentences such as the following

- (139) avec le coq chante[-nt] les poules  
 with the.SG cock sing.SG[-PL] the.PL hen.PL  
 'The hens sing(s) with the cock'  
 dans l'herbe chante[-nt] les grillons  
 in the.SG-grass sing.SG[-PL] the.PL cricket.PL

'The crickets sing in the grass'

resulted in more plural agreement errors on the verb when the local noun was a plausible subject (Example 139) for the verb than when it was not (Example 139). The fact that the similarity of the two nouns leads to more errors is compatible with the theory of head misselection (Bates and MacWhinney, 1989; Fayol et al., 1994). There is also evidence from comprehension that plausibility affects agreement error rates: Greenslit and Badecker (2000) found that response times showed an effect of semantic compatibility of the distractor noun and the main verb.

### *Distributivity*

Another type of semantics which has been investigated for effects on number agreement is distributivity. Conceptual number is manipulated by contrasting sentence fragments that are likely to receive a distributive interpretation (e.g., 102, where there are clearly several bottles each with its own label token) with items that are not (e.g., *the author of the articles*, where there is one author responsible for several articles). Although Bock and Miller (1991) found no effect, Vigliocco et al. (1995) investigated the effects of distributive number in Italian. Participants were presented with preambles consisting of subjects which had either a single token (e.g., Example 140) or multiple tokens in the singular (e.g., Example 141), e.g. (only match conditions are shown),

(140) i gatto sui tetti  
'The cat on the roofs'

(141) i numeri sulle targhe  
'The numbers on the number-plates'

There were more agreement errors in the mismatch than in the match conditions in the singular plural conditions (as in previous work) but also in the plural singular conditions (unlike in previous research), thus suggesting that the singular is not unmarked but is perhaps less strongly marked than the plural (in Italian). Comparing the distributivity conditions, there were more plural attraction errors with singular head nouns in the multiple token conditions (Example 141) than in the single token conditions (Example 140). Thus Italian speakers were found to be sensitive to the distributivity of the subject (i.e. the number of tokens that the subject refers to). This is significant because it means that semantic information

must be available to the processes which determine the number of the verb independently of processes which determine the number of the subject. However, the results are not consistent with those of Bock & Miller (1991). Vigliocco et al. (1995) explained this in terms of cross-linguistic differences between the two languages: Italian has a relatively free word order and is a pro-drop language, thus can allow subjects in positions other than pre-verbal or can allow no subject at all to appear (overtly). Thus, unlike in English, speakers of Italian regularly have to produce agreement before encountering the agreement controller, thus they might be forced use semantic information in a way that, speaking English, one is not, since one can rely upon the information carried by the overt NP subject. Also, Italian has a richer morphology than English, thus it is more often the case that speakers must produce inflectional morphology (from whatever source).

Vigliocco et al. (1996a) replicated these effects of semantics in Spanish, a typologically similar language. More interestingly, however, Vigliocco et al. (1996b) replicated these effects in Dutch and French, both languages which, whilst morphologically richer than English, nonetheless pattern with English rather than Spanish or Italian in important respects (just like English, word order is less free and they are not pro-drop languages). Hence, freer word order and pro-drop cannot explain why Romance languages show distribution effects whilst English does not, suggesting that there must be another explanation for Bock and Miller (1991)'s lack of effects.

Eberhard (1997) found a difference between the two types of singular quantifiers that she used, namely *one*, which evokes the meaning of one token was associated with fewer errors and *each* or *every*, which evoke the meaning of multiple tokens, evoked more errors, and this was the case in both head (Example 142) and local (Example 143) positions.

(142) The / One / Each / Every key to the cabinets

(143) The keys to the / one / each / every cabinet

Although this was a post-hoc analysis, it corroborates other research suggesting that distributivity may affect number agreement processing in English.

Finally in 1999, Eberhard also replicated the distributivity effects in English, finding that single-token items (like Example 140) actually elicited fewer errors than a sentence with distributed tokens of a referent (like Example 141) where there

are clearly several *number – plates* referred to. The previous lack of effects (Bock and Miller, 1991; Vigliocco et al., 1996b) was explained in terms of imageability (see above).

In a similar task, Nicol and Greth (2003) found no difference between speakers' L2 (Spanish) and L1 (English) sensitivity to distributivity, confirming not only that there are no cross-linguistic differences in sensitivity to distributivity, but that speakers of a second language can also be affected. In a similar experiment, Hoshino et al. (2004) found that semantic effects were present in the L1 and L2 of Spanish-English bilinguals, though there were some differences (depending on L2 speakers' competence). Thus it would appear that speakers of any language can and do use the semantics of distributivity in agreement processing, provided that they are competent in that language. Agreement production in the L2 system will be revisited in Chapter 3.

#### *Notional number of individual lexical items*

Bock et al. (1999) investigated the role of collective head nouns in agreement production, whilst at the same time comparing subject-verb agreement with pronoun anaphors. Participants completed sentence fragments such as the following

- (144) The gang leader with the dangerous rival(s)
- (145) The gang leaders with the dangerous rival(s)
- (146) The gang with the dangerous rival(s)

with either a reflexive verb (e.g., *armed*), an intransitive verb (e.g., *vanished*) or nothing in order to elicit reflexives (e.g., *himself, themselves*), tag questions (e.g., *didn't he / they?*) or a verb (e.g., *was / were defeated / strong*). Bock et al. (1999) found that collective nouns such as *gang* did indeed elicit more plural agreement than singular nouns like *leader*.

Bock et al. (2001) also investigated the role of conceptual number in agreement production. They compared pluralia tantum which are conceptually singular (e.g., *scissors*) and pluralia tantum which are conceptually as well as grammatically plural (e.g., *soap suds*). In one experiment, they compared sentences involving an ordinary singular, an ordinary plural and a conceptually singular bipartite

plural (in English) and an ordinary singular, an ordinary plural and a conceptually singular bipartite singular (in Dutch)

- (147) The advertisement for the razor / razors / scissors
- (148) de reclame voor het scheermes / de scheermessen / de schaar  
 the advert for the razor / the razors / the scissors.SG  
 'The advertisement for the razor / razors / scissors'

There were more singular responses in the English bipartite examples (e.g., *scissors*) than in the regular plurals (e.g., *razors*); in Dutch, the bipartites patterned like the singulars. There was virtually no plural agreement in the cases of syntactic singularity after the ordinary singulars (e.g., *razor*, *scheermes* 'razor') nor even after the Dutch bipartite singulars (e.g., *schaar* 'scissors'). Thus, the notional singularity of syntactic plurals results in less plural agreement, suggesting that notional number of the local noun does play a role in attraction, and in agreement processing in general.

Convergent findings where there was no effect of semantics in the local noun position (e.g., Bock and Eberhard, 1993; Eberhard, 1999; Bock and Miller, 1991) and those where there was an effect of semantics in the head noun position (e.g., Bock et al., 1999; Hartsuiker et al., 1999; Humphreys and Bock, 2005; Vigliocco et al., 1995, 1996a,b), resulted in the MMM model (discussed above in Section 1.7.2 and later in Chapters 2 and 3, which proposes that agreement takes place in two stages, such that the notional number of a head noun (or the entire phrase), but not of a local noun, can influence its agreement.

Bock et al. (2004) investigated semantic interference. Participants were presented with sentences including either collective or non-collective local nouns, e.g.,

- (149) The record of the team(s)
- (150) The record of the player(s)

Again, subject-verb agreement involved free completion. Bock et al. (2004) found no plural verbs produced after a singular collective local noun and only two after a singular non-collective local noun (though as in previous studies, collective plurals induced more attraction errors than non-collective plurals, the levels were the same for pronominal as for verbal agreement).

However, the same nouns when in head position do differ with regard to plural agreement. Bock et al. (2004) presented participants with preambles such as the following:

- (151) The team with the commercial contract(s) (won)
- (152) The player with the commercial contract(s) (won)

With collectives in head noun position, verbs were more likely to be plural than with an ordinary singular head (e.g., *player*). Bock et al. (2004) claim that these results provide support for a notion of two different agreement processes, morphing (the implementation of number agreement during processing) and marking (the transformation of notional number into linguistic number). Marking must take place before morphing in normal agreement production, thus a head noun like *team* must be assigned its number value (either singular or plural, according to the semantics or the syntax) before number agreement is computed, explaining variation in number agreement with collectives. During morphing, the number value of the subject (previously assigned during the marking process) will compete with the number value of the local noun and one will win out and be assigned to the verb. This is a purely syntactic process so there is no question of the local noun's semantics interfering with the eventual assignment of a number value to the verb.

In a recent study of notional number, Humphreys and Bock (2005) compared collective subject nouns which were in a context biasing interpretation towards distributive (first example) or collected (second example), e.g.,

- (153) The gang on the motorcycles
- (154) The gang near the motorcycles
- (155) The gang near the motorcycle

They found an extremely strong effect of plural attraction (36% more plural verbs after a plural local noun than after a singular local noun). They found that fragments with a distributive interpretation (e.g., *The gang on the motorcycles*) induced more plural agreement than those with a collected interpretation (e.g., *The gang near the motorcycles*). These were also contrasted with non-collective head nouns, e.g.,

- (156) The delinquents on the motorcycles

- (157) The delinquents near the motorcycles  
 (158) The delinquents near the motorcycle

which can clearly also have more distributed or collected interpretations, but would not be expected to differ with respect to subject-verb agreement induced, since both are grammatically plural, although they could similarly be vulnerable to singular attraction errors. Indeed, it was found that the plural head nouns did not differ significantly with regard to proportion of plural agreement (it is likely that the results were at ceiling level). (Humphreys and Bock, 2005) did find overall differences between collective and plural heads with regard to agreement: the former produced little over half as many plural responses as the latter. Apart from replicating previous collectivity and distributivity effects under more controlled conditions, Humphreys and Bock (in press) have shown that the two interact. This suggests that perhaps all results of agreement difference between collective and non-collective heads could be re-evaluated as effects of distributivity, for instance *the team with the commercial contract* is clearly of distributive meaning as each member of a team must sign their own contract, compared to *the record of the team*, where there is only one record (perhaps detailing the progress of individual members but within one document) (Bock et al., 2004). If so, we would have to say that it is not the individual plural marking or notional plurality of the head noun which makes it capable of influencing agreement (compared to the local noun), but that it is actually the interpretation of the entire noun phrase. It is unclear whether or not this could be extended to account for semantic effects in all noun phrases; it is hard to see how this could account for effects of the plausibility of local noun.

### *Conclusions*

There is clearly a great deal of evidence suggesting that semantics influence agreement and thus that syntax, (assuming that agreement is primarily syntactic,) cannot be encapsulated, but semantics is not the only source of evidence.

#### *1.7.5 Phonology / Morphological form*

As mentioned above (Section 1.2), it is often assumed that formulation proceeds in two distinct stages (Garrett, 1980; Bock and Levelt, 1994). During the first stage, grammatical encoding, lemmas (words including semantic and syntactic properties including number and gender) are retrieved. Morphophonological

encoding takes place afterwards, with word forms (including agreement markers) being retrieved. In a modular framework (Garrett, 1980; Levelt et al., 1999), information flows unidirectionally from top to bottom. As a consequence, a syntactic operation like subject-verb agreement can be affected by the lexical and syntactic features of the subject lemma, but not by its phonological properties at the lexeme level. In a nonmodular interactive approach (e.g., Vigliocco & Hartsuiker, 2002b), there is a bi-directional flow of information between the lemma and lexeme levels, thus phonology can also play a role in agreement.

I will now present evidence from phonology in favour of a nonmodular interactive language production model (Dell, 1986).

#### *Invariable nouns and determiners*

Vigliocco et al. (1995) investigated whether morphophonological form affected number agreement production. Participants were presented with preambles which included either invariant (morphophonologically null) plurals (e.g., *città* or overt plurals (*i* for masculine and *e* for feminine nouns), both of which take a determiner which is marked for gender, and nouns with no morphophonological gender marking on the determiner (*l'*) nor on the noun (*e* is ambiguous) in the singular, e.g.,

- (159) *la città / le città sulla collina / sulle colline*  
 the.F.SG city / the.F.PL city on.the.F.SG hill.F.SG / on.the.F.PL hill.F.PL  
 'The city (cities) on the hill(s)'
- (160) *il viaggio / i viaggi verso l'isola*  
 the.SG journey.M.SG / the.M.PL journey.M.PL to the.SG island.F.SG  
*/ le isole*  
*/ the.F.PL island.F.PL*  
 'The journey(s) to the island(s)'
- (161) *l'interprete / gli interpreti del*  
 the.SG performer.SG / the.M.PL performers.M.PL of.the.M.SG  
*teloromanzo / dei teloromanzi*  
 soap opera.M.SG / of.the.M.PL soap operas.M.PL  
 'The performer(s) in the soap opera(s)'

Vigliocco et al. (1995) found an effect of morphological marking of the subject head noun (but not on the local noun) in Italian, whereby there were fewer errors found after a number alternation involving regular singular - plural alternation (e.g., *il viaggio* 'journey' vs. *i viaggi* 'journeys') compared to invariant nouns (e.g., *la città* 'city' vs. *le città* 'cities') and similarly nouns which had unambiguous gender (e.g., *il viaggio* 'journey') were less susceptible to attraction errors than those which had ambiguous gender in the singular form (e.g., *l'interprete* 'performer'). In a similar experiment, Vigliocco and Zilli (1999) found that both language-impaired and language-unimpaired speakers were sensitive to the morphophonological gender cues, with more errors after invariant heads than after heads marked for gender. This suggests that there are morphophonological influences on agreement from both gender and number, and is inconsistent with a strictly modular unidirectional approach to language production.

#### *Case marking*

Bock & Miller (1991) found that pronouns caused less attraction errors than full noun phrases. This could be due to the overt morphophonology of case marking found on pronouns (but not full NPs) in English. Nicol and Wilson (2000) investigated the role of case marking in Russian. They found similar error rates for both full NPs and pronouns, and these were of the same magnitude as Bock & Miller's pronoun error rates but that the type of noun phrase (full NP or pronoun) had no effect, suggesting that the discrepancy between pronouns and full NPs in English was indeed due to case marking.

Hartsuiker and colleagues have found effects of morphophonological case marking on agreement processing in German and Dutch (Hartsuiker et al., 2001, 2003). Hartsuiker et al. (2001) showed that an object pronoun in pre-verbal position (linearly intervening between the subject and the inflected verb in embedded clauses) only acted as an attractor when the case marking of the pronoun was ambiguous between nominative and accusative, and not when it was unambiguously accusative.

#### *Ambiguous determiners*

Similarly, Hartsuiker et al. (2003) showed that the case and number marking of the determiner in the local noun was significant in attraction errors with Dutch pronouns, errors being more common when the determiner form was ambiguous between accusative and nominative (*ze*, ambiguous between 'them', 'she',

'they') than when it was unambiguous marked for accusative (non-subject) (*hen* 'them'). They likewise found that when the determiner of a German noun phrase was ambiguous between accusative and nominative, the local noun was more of an attractor than when the determiner was unambiguously dative (i.e. non-nominative). Also, when the determiner of the head was ambiguous between singular and plural, there were more plural attraction errors. Ambiguity of case in the head noun had no effect. They replicated this effect in Dutch, when the gender of the head noun was ambiguous between singular common gender and plural (*de*), there were more plural attraction errors than when the head noun was unambiguously marked by the singular neuter gender determiner *het*. These results show that there are morphophonological influences on subject-verb agreement in both head and local noun position, consistent with either a model of language production which allows direct feedback (e.g., Dell, 1986), a model allowing monitoring by access to later processes (e.g., Levelt, 1983; 1989), or a model in which both morphemes and frames carry syntactic feature specifications (e.g., Bock et al., 2001).

#### *Morphological regularity in English plurals*

Haskell & MacDonald, 2003, found a trend towards differences between local nouns with typical plural marking (e.g., *rats*) versus irregular plurals with idiosyncratic marking (e.g., *mice*) in English). They found that phrases with regular local nouns had a significantly higher mean plurality rating than phrases with irregular local nouns, which suggests that morphological regularity might influence the conceptual representations of the stimulus phrases themselves. They thus partialled out conceptual plurality in a regression, and found that there was still a weak effect of regularity. This requires further investigation, but it strongly suggests that morphophonology is influencing agreement processing here too.

#### *Number and case ambiguity*

Mirković et al. (2005) found with Serbian nouns that homophony with nominative singular form in feminine nouns promotes the use of singular verbal agreement with a feminine genitive plural (e.g., *5 krava* '5 cows') but not with the masculine (e.g., *5 konja* '5 horses') when either singular or plural agreement is grammatically correct. They also found that homophony with feminine singular form in masculine nouns promotes the use of singular verbs when not grammatical i.e. there were less agreement errors after the non-homophonous feminine

(e.g., *4 krave*) than after the homophonous masculine (*4 konja*). This suggests that morphophonology can influence agreement in a language with an extremely rich morphological system, and in the case of indisputably correct agreement as well as what are usually referred to as errors, thus it would appear that morphophonology can influence normal agreement.

#### *Markedness versus overttness*

Some persuasive evidence for the role of morphophonology comes from Smyth and Nicolau (2000). Since overttness and markedness are confounded in English number, Eberhard (1997) examined the effects of specifying number with quantifiers. The singular is also unmarked in Romanian, but it can be either null or overt. Smyth & Nicolau found that these two types differ considerably, demonstrating that overttness does play a role in agreement errors independently of markedness. They found fewer errors overall than are usually found, but amongst them, there were far more errors on local singulars when they were overt and there were fewer local plural errors when the head had overt singular inflection; they also found that when both the singular and the plural were overt, there were far more singular errors (PSS) than plural errors (SPP), suggesting that overt singulars are, in some sense, less marked than null singulars and more marked than overt plurals. Finally, they found that an additional singular definiteness marker on uninflected singulars caused very few errors, whereas the definiteness marker led to very high error rates on inflected singulars. Except for the fact that there were more singular than plural errors, these findings are in line with those of Eberhard (1997). However, Smyth and Nicolau (2000) explain them in terms of overttness. Indeed, considering the difference between null and overt marking in Romanian, we would have to conclude that it is overttness that is the dominant factor. This is not inconsistent with a markedness hypothesis, however, since, as Smyth & Nicolau (2000) point out, overttness is a criterion for markedness. The English singular-plural asymmetry can thus be explained in terms of the overttness of the inflection: when looking at present tense verbs in the third person in English, unlike nouns, which tend to add a suffix (regularly /s/) in the plural, it is the singular which tends to add a suffix (regularly also /s/), thus we see less morpheme addition than deletion. However, this is perhaps more likely with regular verbs than with the copula (with *have-has* perhaps falling somewhere between the two) since there are two distinct forms for third person singular (*is*) versus first person plural (*are*) although the latter is still used in a wider variety of contexts (i.e. second person and first person plural)

than the former (which is exclusively used for third person singular), and the former is still phonologically similar to regulars (in that it ends in /z/)<sup>15</sup>. The Romanian findings strongly suggest that morphophonological overtiness influences agreement, and that therefore the agreement processor must have access to phonological information.

### *Conclusions*

Taken together, the research on the influences of morphophonological form on agreement production suggests that the flow of information cannot be unidirectional but must allow for feedback from phonological encoding to grammatical encoding.

#### *1.7.6 Linear proximity*

In response to Vigliocco & Nicol's (1998) claim that linear word order plays no part in subject verb agreement processing, several researchers have endeavoured to find a proximity effect. This has been achieved in coordination. Recently, Haskell & MacDonald (2003, 2005; in English) and Hemforth & Konieczny (2003; in German in a written task) have shown that sentences such as the following do have different completion patterns, with proximity dictating what number value will be preferred:

(162) Is the hat or the gloves on the table?

(163) The hat or the gloves are on the table.

Results are somewhat similar despite differences in the task. Haskell and MacDonald (2003), gave participants a preamble like *the hat or the gloves* and asked them to form either a question or a declarative sentence. Haskell and MacDonald (2005) showed participants pictures of the conjuncts (e.g., a picture of a hat and a picture of some gloves) and asked them to form questions; Hemforth & Konieczny asked participants to fill in the gap for the verb in a written questionnaire). This suggests that linear word order must be processed before agreement is fully specified, which again suggests that a modular system with semantics

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<sup>15</sup>Similarly, in the past tense, there are two distinct forms for first person singular (*was*) versus first person plural (*were*) although the latter is still used in a wider variety of contexts (i.e. second person and first person plural) than the former (which is only used for first and third person singular only), and the former is still phonologically similar to regulars (in that it ends in /z/).

and syntax (including agreement) being specified at the lemma level without access to information about “later” processes like linear word ordering cannot be accurate. Haskell & MacDonald (2005) also conducted an off-line survey (after Peterson, 1986) rating sentences such as

(164) Can you ask Brenda if the boy or the girls is / are going to go first?

(165) Can you ask Brenda if the girls or the boy is / are going to go first?

There was an overall preference for agreement with the nearest noun phrase. Hemforth & Konieczny’s (2003) study produced similar results, and will be discussed in Chapter 5.

Haskell & MacDonald (2005) also conducted an experiment asking participants to produce sentences of the type shown above, again using picture cards, e.g.,

(166) Can you tell me whether the horses or the clock is / are red?

This structure, or perhaps the fact that the verb follows the subject (rather than preceding it in the bare interrogatives of the original experiment), resulted in much stronger effects in the SP (singular plural) condition than in the PS condition (reflecting written corpus tendencies).

Franck, Vigliocco & Nicol (2002) compared two attractor nouns, in sentences such as

(167) l’ordinateur avec le programme-0 de-s expérience-s  
 the computer with the.SG program-SG of.the-PL experiment-PL  
 ‘The computer with the program of the experiments’

(168) l’ordinateur avec le-s programme-s de l’-0 expérience-0  
 the computer with the.PL program-PL of the-SG experiment-SG  
 ‘The computer with the programs of the experiment’

According to any account of linear distance or proximity, the second attractor noun (e.g., *expérience(s)*) would be expected to cause more errors, however, if agreement is sensitive to syntax alone, the first attractor (e.g., *programme(s)*) is closer to the head - and to the verb - than the second (e.g., *expérience(s)*), thus it would be more likely to cause interference, since the latter is more deeply embedded, as shown below:

(169) [l'ordinateur [avec les programmes [des expériences]]]

Franck et al. (2002) found that errors were in fact caused only by the first attractor (e.g., *programme(s)*) and not at all by the linearly closer but syntactically more distant second attractor (e.g., *expérience(s)*), suggesting that the syntactic distance rather than the linear proximity was uniquely responsible for the errors. This also rules out the clause packaging hypothesis (Bock & Cutting, 1992) where elements which share similar structural properties within a clause are potentially interfering in their competition for the same mechanisms. In fact, although both attractor nouns are in the same clause, they have vastly different effects on the agreement process. Overall, however, this research clearly shows that linear order (of both subject with regard to verb, and of individual conjuncts) can influence subject-verb agreement.

#### 1.7.7 Processing resources

Bock & Cutting (1992) found some evidence for the role of memory in agreement processing. In sentences where the attractor was embedded in a clausal (Example 170), rather than a phrasal (Example 171) post-modifier, intervening material caused more attraction errors (though where it was in the same phrase, it did not), thus there were the same number of errors in the first example irrespective of length

(170) The report of the destructive (forest) fires

(171) The report that they controlled the (forest) fires

but errors differed according to length (inclusion of parenthetical material) in the second. They interpreted this as evidence for clausal insulation, but it could be argued that it is memory which makes material in the same clause more difficult to isolate from the current agreement process, and it is difficult to think of any other explanation for the increased difficulty caused by the increased length in a different clause.

There is evidence that working memory influences agreement processing (Fayol and Got, 1991; Fayol et al., 1999, 1994; Hupet et al., 1996). Fayol et al. (1994); Largy et al. (1996) have shown that participants make subject verb agreement errors in written French when they have to transcribe sentences with an intervening full noun phrase (e.g., 139) or pronoun (*les*) like the following:

- (172) le garçon fait des erreurs. Il les gomme  
 the boy makes some mistakes. he them erase.SG  
 'The boy makes mistakes. He erases them'

Subject-verb agreement errors in written French were found to be between two and five times more frequent when a secondary task was added to the sentence recall / completion task, for example when the participants had to count clicks (Fayol et al., 1999). Largy et al. (1996) propose a two-step processing model to explain their findings: the first step is the automatic activation of a verb with the appropriate number value corresponding to the nearest noun; the second is an editing process which allows the writer to check for agreement errors. When participants have a high cognitive load, they are reliant on the first step; when there are cues (such as semantic implausibility) to suggest that the local noun is not the subject of the sentence, the editing process is more likely to be implemented.

More recently, however, Hartsuiker and Barkhuysen (2006) examined language production and varying capacities of working memory in normal participants. They compared subject-verb agreement of participants with various speaking spans (a measure of verbal working memory for sentence production) in spoken sentence completion, while speakers did or did not maintain an extrinsic memory load (a word list). They found that agreement errors varied according to memory span and memory load, and that these variables interacted, with memory load only affecting low-span speakers. Number distributivity did not interact with either load or span. This strongly suggests that agreement processing is affected by verbal working memory limitations.

Hoshino et al. (2004) found that individual differences in working memory capacity in monolinguals and in L2 proficiency in bilinguals have similar cognitive constraints on the processing of subject-verb agreement. Semantic information comes into play during syntactic processing such as the processing of subject-verb agreement only when individuals have processing resources available. This may well account for apparent cross-linguistic differences in susceptibility to distributivity: Vigliocco et al. (1996a) found that English and Spanish subject-verb agreement differed in susceptibility to interference from different types of variables (but cf. Nicol and Greth, 2003; Hoshino et al., 2004).

As discussed above, extensive research (e.g., Hartsuiker et al., 1999; Vigliocco et al., 1995, 1996a,b) has found that sentence fragments that are likely to receive a distributive interpretation induce many more agreement errors than non-

distributives. Hartsuiker et al. (1999) tested the ability of aphasic patients compared to normals in a sentence completion task involving distributive or non-distributive subjects. However, there was no such effect in speakers with aphasia (Hartsuiker et al., 1999), suggesting that the production of verb agreement is at least partially constrained by verbal working memory resources, since aphasics suffer from a pathological reduction in these resources. Hartsuiker and colleagues (Hartsuiker and Barkhuysen, 2006; Hartsuiker et al., 2003) showed somewhat conflicting results regarding the effects of limitations of computational resources on agreement processing. Although they found effects of memory span and of memory load, and they also found that these variables interacted: memory load affected only low-span speakers; unlike Hoshino et al., they found that distributivity did not interact with either load or span.

Almor et al. (2001) directly compared subject-verb agreement and anaphor resolution to ascertain whether it was the working memory requirements, the distance between the dependent constituents, or the nature of the dependency probed (i.e., grammatical in the case of subject-verb agreement or discourse in the case of anaphora) which Alzheimer's disease patients found problematic. They found that whilst length of intervening material did not have any effects per se (as for healthy unimpaired participants in Bock & Miller, 1991), and performance was not correlated with performance on working memory tasks, there was a difference between the two types of agreement. Whilst Alzheimer's patients did not differ from healthy controls in the subject-verb agreement task, they were impaired on the anaphora task.

### *Conclusions*

Evidence from native and non-native speakers, from patients and healthy participants, all suggests that agreement processing is to some extent affected by working memory limitations. Interestingly, according to Franck et al. (2002), it is not the presence of marking per se that explains the asymmetrical pattern of errors commonly observed in attraction studies, but rather, the fact that marking increases the processing load. Franck et al. (2002) found in their study of head nouns post-modified by two local nouns that there were more errors in the plural head condition (i.e. PSP) than in the singular head condition (i.e. SPS) in French, and even in English, in contrast to many previous studies (e.g., Bock and Cutting, 1992; Bock and Eberhard, 1993; Bock and Miller, 1991; Fayol and Got, 1991; Fayol et al., 1994; Hartsuiker et al., 2003; Hupet et al., 1996; Vigliocco et al., 1995, 1996a)

there were a large number of singular attraction errors. They claim that plurals may be inherently more complex, thus, it is often merely that singular attraction errors are small compared to the number of random agreement errors found with a plural head and a plural local noun whereas there are often few or no errors in the singular singular condition, compared to numerous errors after a plural attractor (Bock and Cutting, 1992; Bock et al., 1999; Hemforth and Konieczny, 2003; Thornton and MacDonald, 2003; Vigliocco and Nicol, 1998; Vigliocco et al., 1995, 1996a); in fact, the lack of singular attraction effects has been so well established that many researchers do not even test plural heads at all (e.g., Eberhard, 1999).

### 1.7.8 Frequency

Bock & Miller (1991) claimed that simple frequencies could not explain attraction errors, since *were* is three times less common than *was* and yet is a much more common error (frequencies from Kučera & Francis, 1967). Barker & Nicol (2000) investigated whether the asymmetry between singular and plural attraction errors could be due to frequency of lexical items in either singular or plural form. They compared nouns with a more common plural (as in the first example) or a less common plural (as in the second):

(173) The donation from the banker(s) was extremely generous

(174) The donation from the senator(s) was extremely generous

The task was that of grammaticality judgement, with reading times and error rates measured. Barker & Nicol (2000) failed to find any interaction between local noun number and frequency, but they did find that nouns with a more common plural were harder overall, thus there was an effect of frequency.

Bock, Eberhard, & Cutting (2004) appeal to frequency to explain why they find more plural attraction with collective plurals than with non-collectives (collectives being less commonly pluralised). They propose that the relative frequency of a morphed form affects its likelihood of spuriously attracting an agreement target.

### 1.7.9 Conclusions

Whether the language production system is feed-forward or involves feedback is still an open question. There is evidence suggesting that agreement is directed

by syntax and is not influenced by other factors such as semantics or phonology, but there is a growing body of counter-evidence suggesting that perhaps whilst syntax is clearly primary, other factors may influence agreement production to varying degrees.

## 1.8 Other issues

### 1.8.1 *Are gender and number agreement the same process?*

Antón-Méndez, Nicol, & Garrett (2002) addressed the question of whether gender and number agreement are processed separately, and also whether subject-verb agreement and subject predicative adjective agreement are a unitary process. Their study was carried out in Spanish. They compared preambles like the following (match gender conditions only shown)

(175) el terreno del establo / de los establo-s  
 the.M.SG lot.M.SG of.the.M.SG stable.M.SG / of the.M.PL stable.M-PL  
 ‘the lot of the stable/s’

(176) la vista de la playa / de las playas  
 the.F.SG view.F.SG of the.F.SG beach.F.SG / of the.F.PL beach.F.PL  
 ‘the view of the beach/es’

fully crossing number of local noun and gender of head and local noun. They found that the pattern of gender errors showed a sensitivity to number mismatch and (to a lesser extent) that of number errors showed a sensitivity to gender mismatch, but overall, their effects were independent. Surprisingly, gender errors were more likely when the two nouns were singular, and number errors were more likely when the two nouns had the same gender, which is compatible with the theory of head misselection (Bates & MacWhinney, 1989; Fayol, Largy & Lemaire, 1994). However, it is possible that their results would not be applicable to other languages, since in Spanish, gender and number morphemes are clearly agglutinative, with an *s* being added to the extant noun (in over 60 percent of cases, ending in *a* if feminine and *o* if masculine) and at least one determiner<sup>16</sup>,

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<sup>16</sup>In Spanish, the feminine plural determiner is clearly related thus to the singular determiner, whereas in masculine, we must appeal to etymology: the determiners evolved from the demonstratives, thus masculine *ellos* was the plural counterpart to the singular masculine determiner *el*; now, however, the plural determiner has been reduced to *los* and is not therefore transparently related to the singular.

whereas in other languages, the morphemes are fusional, with a portmanteau morpheme which cannot be further decomposed, e.g., in Italian, whilst many singular nouns resemble Spanish nouns ending in *a* if feminine and *o* if masculine, plural nouns tend to end in *e* if feminine and *i* if masculine, thus gender and number are fused into two portmanteau morphemes, as shown below (first Spanish, then Italian),

(177) el cirio / los cirio-s  
 the.M.SG candle.M.SG / the.M-PL candle.M-PL  
 'The candle / the candles'

(178) la lámpara / la-s lámpara-s  
 the.F.SG lamp.F.SG / the.F-PL lamp.F-PL  
 'The lamp / the lamps'

(179) il cero / i ceri  
 the.M.SG candle.M.SG / the.M.PL candle.M.PL  
 'The candle / the candles'

(180) la lampada / le lampade  
 the.F.SG lamp.F.SG / the.F.PL lamp.F.PL  
 'The lamp / the lamps'

They found that gender and number agreement are processed separately, since the number of combined (gender and number) errors did not exceed the number which would be expected if they co-occurred by chance. The targets consisted of a copula verb and an adjective. They also found that subject-verb agreement and subject predicative adjective agreement are a unitary process, since they did not observe separate errors on the adjectives which did not occur on the verbs or vice versa, i.e. the number of combined errors did exceed what would be expected by chance co-occurrence. In fact, there are no independent errors at all. The results show that number and gender are independent, at least in Spanish, for the purposes of agreement, and is compatible with features being the source of the errors (Bock and Eberhard, 1993; Vigliocco and Nicol, 1998) rather than head misselection (Bates and MacWhinney, 1989; Fayol et al., 1994).

### 1.8.2 Methodological issues

The following section compares the methodological details between experiments examining subject-verb agreement in the literature.

*Stimulus modality*

The written tasks have aural (dictated) (e.g., Fayol and Got, 1991; Fayol et al., 2007, 1999; Hupet et al., 1996) or written (Hemforth and Konieczny, 2003) stimuli. Spoken tasks may involve aurally or visually presented preambles. Bock & Miller (1991) presented the stimuli aurally to the participants, who were instructed to repeat and complete the preambles orally. Bock & Miller (1991) presented sentence preambles to their participants by merely reading them out, but subsequent experimenters have recorded their stimuli in advance, splicing out gaps and controlling for length Bock and Eberhard (1993); Bock and Cutting (1992); Bock et al. (2004, 1999); Hartsuiker et al. (2003); Meyer and Bock (1999); Thornton and MacDonald (2003). Later experiments prefer to present stimuli in written form (e.g., Bock et al., 2006; Franck et al., 2002; Haskell and MacDonald, 2003; Nicol and Greth, 2003; Vigliocco and Franck, 1999, 2001; Vigliocco et al., 1996a). Humphreys and Bock (2005) compared aural to written stimuli. They found that auditory presentation elicited more number-inflected responses and fewer miscellaneous responses than did visual presentation. It also produced significantly more plural responses and significantly fewer miscellaneous responses than did visual presentation. However, their more subtle distributivity manipulation was not affected by modality. Finally, Haskell and MacDonald (2005) developed a task that provided number information in a more meaningful way; participants were presented with two pictures, depicting either a single object, or a pair of identical objects. The task required the participant to identify which of the two pictures had a certain property by asking the experimenter, thus eliminating the memory requirements of the fragment completion task.

I use written stimuli, as this constrains the completions to the correct lexical item (crucial for gender manipulations) in a way that images could not easily do, does not artificially increase the number of responses of a certain type, and ensures no presentation differences between items due to speaker variability.

*Response type*

Most completions are oral, but there is some research using written completions, and some experimenters employ an additional task in order to increase working memory load. Oral completions involve participants listening to or reading a preamble, and then repeating it and completing the sentence using their

own completion (e.g., Bock & Miller, 1991; Bock & Cutting, 1992; Bock & Eberhard, 1993; Nicol, 1995; Vigliocco et al., 1995; Vigliocco et al., 1996a; Vigliocco & Franck, 1999). In an internet-based experiment, Hemforth and Konieczny (2003) used written completions with written stimuli, where participants had to fill in the gap in a sentence. The French tradition uses the written medium much more (e.g., Fayol and Got, 1991; Fayol et al., 1999, 2007; Hupet et al., 1996). The task is slightly different: sentences are dictated, since the difference between the singular and plural conjugations of verbs are generally orthographic but not phonographic. Fayol et al. (1994); Largy et al. (1996) showed that educated French adults make subject-verb agreement errors when they have to transcribe sentences such as Examples 172, where an intervening plural object pronoun may induce an attraction error. These errors were two to five times more frequent when a secondary task was added to the written recall requirement, for example when the participants had to count clicks (Fayol, Hupet & Largy, 1999), suggesting that working memory load is crucial in subject-verb agreement. Hoshino et al. (2004) attributed differences in subject-verb agreement error rates to (lack of) cognitive resources: individual differences in reading span and verbal fluency modulated sensitivity to distributivity.

#### *Free versus constrained completions*

Clearly, the most constrained task is that of writing down a dictated sentence. In the case of (written or oral) sentence completion tasks, they can be either constrained or free. Hemforth and Konieczny (2003) used extremely constrained completions, in the sense that they asked participants to fill in gaps with a missing auxiliary verb.

Bock & Miller (1991) presented sentence preambles to their participants and merely instructed them to repeat and complete the preambles orally in whichever way those chose. Many other experimenters have opted for free completions (e.g., Bock and Eberhard, 1993; Bock et al., 2001; Hartsuiker et al., 2003).

In Bock et al. (1999), four different types of completions were elicited: verbs, pronouns, tag questions and reflexives (see also Bock et al., 2004). The preambles differed (verb-eliciting preambles consisted of a subject noun phrase with a prepositional phrase, pronoun-eliciting preambles also had a past-tense verb, and tag-eliciting pronouns included an intransitive verb, and reflexive-eliciting preambles included a reflexive) according to experimental condition.

In the case of constrained completions which require only one type of completion, the adjective may be given in its bare root form (Antón-Méndez et al., 2002), or in an inflected form that is either congruent or incongruent (Vigliocco et al., 1996a); an uninflected adjectival or verbal form may be given (Thornton and MacDonald, 2003); or finally, more than one form of an adjective may be given (Vigliocco & Franck, 1999; 2001), with the position of each form (presented higher or lower on the screen), counterbalanced across items. Vigliocco et al. (1995) compared free and constrained (inflected adjectival) completions. The adjectives were presented in the written modality. They found a similar pattern of errors after both, though of a greater magnitude with constrained completions.

I used constrained completions in the attraction error experiments, in order to induce more completions. A verb was presented to the Slovene participants, but in English, it was necessary to adapt some of the materials to adjectives, since only *have* and *be* show agreement in the impoverished morphology of English. Free completion was used in the conjuncts experiments. Following Antón-Méndez et al. (2002), who found that the agreement process was unitary (one process) whether agreement was with an adjectival or a verbal predicate, it is not deemed to affect the outcome and in two experiments, examples with adjectives were given (in all experiments, agreement on verbs and adjectives was analysed).

#### *Time constraints*

Bock & Miller (1991) presented sentence preambles to their participants by merely reading them out, even allowing participants to request repetitions. Since then, timing has been more constrained. The presentation times used in some experiments (Vigliocco, Butterworth, & Garrett, 1996; Vigliocco & Franck, 1999; Vigliocco & Franck, 2001) in which adjectives and sentence preambles were used were sufficiently long to allow full comprehension of the materials, namely the sentence preamble was presented for 900 ms and then adjectives were presented for 500 ms. Franck et al. (2002) used even longer completion times: presentation times were 3000 ms for both experimental and filler items. Vigliocco and Nicol (1998) presented a fixation cross, presented for 400ms, an adjective presented for 600ms, a blank interval of 450ms, followed by the sentential preamble for 890ms. The inter-trial interval was self-paced; participants were instructed to press the space bar to advance to the next trial. I followed this structure, but

adapted the timings according to the length of the materials. I pretested the materials to allow completion, since my materials were mostly slightly longer. Presentation times ranged from fixation point 680ms, preamble 1400ms, warning after 1360ms for the conjuncts (the shortest items) to fixation point 400ms, verb 680ms, fixation point 450ms, sentence preamble 1750ms, audio warning 1700ms and for L2 speakers (who clearly require longer to process the words in a foreign language), fixation point 400ms, verb 800ms, fixation point 450ms, sentence preamble 2500ms, audio warning 2760ms.

### 1.8.3 Conclusions

There is substantial evidence for interaction between lexeme and lemma levels during agreement production from morphophonology, as well as some indications from evidence concerning word order. There is also substantial evidence of an influence of semantics (distributivity, collectivity, biological gender, animacy, plausibility and imageability) on agreement processing, but most points to a limitation, with perhaps only the semantics of the head noun or the whole subject (rather than of individual words such as the local noun attractor) being involved in agreement production. Evidence from comprehension, and written as well as oral production, seems to be broadly in line with that from production. Processing resources (or a lack of them) can influence (erroneous) grammatical agreement.

## 1.9 Implications for agreement production

Theories of language production claim to be universally valid, but are almost entirely based on experimental data from a limited range of languages (e.g., Bock & Levelt, 1994; Garrett, 1980). Even more than in language comprehension, English language experiments are dominant. This is a particular problem for theories of sentence production, because English has an impoverished morphology and consequently a strict word order, neither of which are representative of most languages of the world. I am therefore conducting research into language production in Slovene, a Slavic language which is typologically very different from English (Herrity, 2000; Priestly, 1993).

I am exploring the production of subject-verb agreement. I use a paradigm designed to elicit agreement errors (Bock & Miller, 1991). I propose to use my results to develop current accounts of syntactic formulation during language production. Language production can be seen as comprising four stages: conceptualisation, grammatical encoding, phonological encoding, and finally articulation. Agreement is generally assumed to take place at the stage of grammatical encoding (Levelt, 1989). This is the stage at which the information in the discourse model dictates which lexical representations are retrieved and the syntactic structure which is constructed. In a modular system, information flow is unidirectional, so at the point at which agreement is computed, there should be no access to information from outside the grammatical encoding (Bock & Levelt, 1994; Garrett, 1980). This means that, on this account, semantics cannot interfere with the agreement process. Evidence is divergent, however, on the extent of encapsulation and exactly how semantics can influence agreement. Much evidence points to a role for the semantics of the subject noun phrase at an early stage when agreement feature values are decided, but no possibility of later influences. There is some evidence which does not fit in with model. This thesis explores whether semantics influences agreement and in what ways. Agreement is claimed to be computed after grammatical functions have been assigned and prior to linear ordering (Bock & Cutting, 1992; Vigliocco & Nicol, 1998). This means that, on a modular account, later processes should not influence agreement, yet there is some evidence that morphophonology and linear word order may affect agreement. This thesis therefore investigates whether linear word order can have an effect on agreement. Finally, agreement errors are often found to be asymmetric (e.g., Bock & Miller, 1991), such that singular head nouns followed by a plural local noun are often associated with plural errors (compared to a baseline of singular head nouns followed by a singular local noun) but plural heads nouns are not associated with singular errors (compared to an analogous baseline). This has been explained in terms of a markedness hypothesis (Eberhard, 1997) whereby singular nouns are susceptible to but do not cause errors because they are unmarked, whereas plural nouns, being marked, are relatively unsusceptible to and do cause errors. However, this is not the case for all languages - French and Italian experiments have failed to replicate this asymmetry. I exploit the three way number and gender systems in Slovene to investigate whether an explanation clearly predicated on a binary system has any explanatory power for a tripartite system. Overall, I hope to address the more general question of whether a language-universal theory of language production is possible.

## CHAPTER 2

### Markedness

#### 2.1 The effects of markedness on the production of number agreement

Theories of the process of implementing agreement across a distance in the sentence are typically based on languages such as English or other languages which have two number values: singular and plural. It is claimed that the reason why people make agreement errors<sup>1</sup> using the plural after a complex NP subject like *a farmer with some cows* is because the local noun (*cows* in our example) is plural (Bock and Miller, 1991). However, it has been observed that they do not tend to use the singular after *farmers with a cow*, or at least that this latter type of error is less common. Bock and Miller (1991) attributed this to the idea that singulars are phonologically null whereas plurals are phonologically overt, but Eberhard and colleagues (Bock and Eberhard, 1993; Eberhard, 1997) propose that the asymmetry is due to the morphosyntactic feature markedness: the singular is unmarked, while the plural is marked. In this chapter I will examine whether this claim holds for other languages, and in particular, if it makes sense for a language with a tripartite rather than a bipartite number system. Assuming that the singular is the least marked form cross-linguistically, there are two possible assumptions about the markedness of non-singular number values: they are equally marked with respect to each other and the singular or there is

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<sup>1</sup>Note that in some dialects of English, a verb form which is singular in the standard language may be grammatical with a plural subject and vice versa. This does not affect the comparison of the rates of production of a particular form after a local noun with matched or mismatched number, and I shall thus refer to these phenomena as “errors”, although they may be grammatical utterances for a particular speaker.

also a markedness distinction between them. In the latter case, the dual may be assumed to be more marked than the plural<sup>2</sup>.

I shall begin by explaining the concept of markedness, then showing why certain number values are deemed to be marked, then I shall explore whether markedness can explain previous findings in the literature, before moving on to explore the explanatory power of markedness in a language with a more complex number system.

Specifically, I will report two experiments that examine agreement following complex subject NPs involving a head noun and a local noun. In Experiment 1, I examine agreement following head nouns post-modified by a relative clause including a local noun that matches or mismatches in number with the head noun in order to test whether attraction effects are also found in languages with more complex number systems, whether markedness can elucidate the pattern of agreement errors found in Slovene, and specifically whether Eberhard's (1997) predictions hold for Slovene. In Experiment 2, I examine agreement following complex subject NPs which do not involve a relative clause to test whether or not the structure of the complex NP affects the pattern of agreement errors found.

### 2.1.1 *What is markedness?*

The concept of markedness was developed in relation to phonology by Trubetzkoy and Jakobson, members of the Prague School of Linguistics, around 1930 (Jakobson, 1990). Trubetzkoy's use of the term was restricted to phonological oppositions, but Jakobson extended this to semantic oppositions such as verbal aspect in Russian and the difference between general terms (e.g., *dog*) which are unmarked and specific terms (e.g., *bitch*) which are marked (Haspelmath, 2006). Jakobson stated that Trubetzkoy "came to the conclusion that "only one of the terms of a correlation is perceived as actively modified and as positively possessing some mark, while the other term is perceived as lacking the mark and as passively unmodified" [...]"'. The most important criterion for markedness was neutralisation (e.g., word-final devoicing suggests that unvoiced is the unmarked category and voiced the marked, since in a context where the contrast is neutralised, it is the unvoiced variant which is found) (Croft, 1996).

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<sup>2</sup>I use "plural" in the conventional way to refer to the number value in English and Slovene by that name, whilst bearing in mind that in Slovene, the plural is narrower than in English, since it excludes cases where the dual is used.

Although the members of the Prague School restricted the study of markedness to within languages, Greenberg (1966) redefined it as a universal asymmetry. He attempted to reconcile complexity, difficulty and abnormality in the term markedness (Haspelmath, 2006). Greenberg (1966) proposed eight criteria for markedness, including frequency within a particular language (unmarked elements being more frequent and occurring in more environments), frequency between languages (unmarked elements occurring in more languages than marked elements and the latter occurring only in the presence of the former), being a default within a particular language, i.e. a value used automatically if no other value is specified (e.g., *-s* plural is the unmarked nominal or default plural in English, since it is used even for non-words - Berko, 1958) and being the more general category (e.g., *tall* is both the opposite of *short*, as in Example 181 and the more general term for height which includes both values and any height in between, as in Example 182), syncretism (e.g., English plural is clearly more marked than the singular because the singular can express gender and the plural has lost that differentiation), and finally the “*signe zéro*” or “the zero expression of the unmarked category” (e.g., in the example in Table 2.1, the (masculine) nominal case and singular number are least marked because they are realised by no overt marker).

(181) I am short but he is tall

(182) How tall are you? Are you more than three feet tall?

### 2.1.2 *Is the plural marked with respect to the singular?*

According to Greenberg (1966)’s criteria for markedness, the plural is more marked than the singular, at least in languages like Slovene and English, for several reasons.

Firstly, the singular is more common cross-linguistically and the plural only occurs in a language if it also has the singular, whereas a singular may occur without a plural (Greenberg, 1966).

Secondly, the singular is more frequent overall within languages (Jakopin, 1999, e.g., in literary Slovene it accounts for around two thirds of all number-marked material) (although individual lexical items may have a more frequent plural than singular form (e.g., *clothes* in English, *začimbe* ‘spices’ in Slovene)).

Number	Case	Noun
sing	nom	volk
sing	gen	volka
sing	dat	volku
sing	acc	volka
sing	loc	volku
sing	inst	volkom
dual	nom	volkova
dual	gen	volkovov
dual	dat	volkovoma
dual	acc	volkova
dual	loc	volkovih
dual	inst	volkovoma
plural	nom	volkovi
plural	gen	volkovov
plural	dat	volkovom
plural	acc	volkove
plural	loc	volkovih
plural	inst	volkovi

Table 2.1: Example declination of masculine noun *volk* 'wolf'

Thirdly, it is used generically, for instance, in questions, the generic *wh*-element is singular, as in Examples 183 and 184.

- (183) kdo je prišel?  
 who AUX.SG came.M.SG  
 'Who has come?'
- (184) kaj je zgodilo?  
 what AUX.SG happened.N.SG  
 'What happened?'

In Slovene the animate version tends to be masculine singular and the inanimate neuter singular - although plural full NP versions exist, e.g., *Which people came?*. The singular tends to be used in questions, although there are exceptions such as Example 185 in English in which the singular form would be the more marked one.

- (185) Do you have children?

Empty subjects are also singular, e.g.,

- (186) dežuje  
rain.SG  
'It is raining'

Fourthly, some languages, such as Turkish, Hawaiian and Japanese, have a form underspecified for number which can also be used as a singular (whereas the plural is unambiguously plural) (Corbett, 2000; Hawkins, 1982).

Fifthly, the singular is often simpler in form, involving zero-marking in the nominative; this is the case for Slovene masculine nouns and verbs, e.g.,

- (187) konj-0 rezgeta-0  
horse-SG neigh-SG  
'The horse neighs'
- (188) konj-i rezgeta-jo  
horse-PL neigh-PL  
'The horses neigh'

Haspelmath (2006) refers to this as constructional iconicity.

The third person singular is regarded as the least marked person (Greenberg, 1966) yet the English third person singular verbal agreement morpheme violates some of these criteria in carrying an overt suffix *-s*, whereas all of the other person-number combinations have no overt suffix (Jensen, 1990). Tiersma (1982) coined the phrase "local markedness" to capture the idea that although there may be global preferences (say, for zero morphophonological realisation of the unmarked form), locally, these may be violated. There are few exceptions (e.g., Slovene feminine and Russian (ungendered) genitive plural is zero marked; Icelandic marks nominative singular but has zero marking on nominative plural Croft, 1988)).

Diachronic change also provides evidence for a tendency to prefer the unmarked form to be singular though (witness the change from plural to singular meaning in the following English nouns: *data, opera, algae, bacteria, graffiti*; Old French

and Provençal had nominative singular marking on nouns but zero marking in nominative plural, but this is no longer the case) (Croft, 1990)<sup>3</sup>.

Although the concept may be acquired early, with the ability to count and even understand simple arithmetic as infants (Dehaene, 1997; Wynn, 1998), plus using words such as “many”, “more” or a number coupled with the singular nominal form to express plurality (Clark and Nikitina, 2009), children acquire most plural forms later than singular forms (Berko, 1958; Clark and Nikitina, 2009; Corbett, 2000; Petrič, 2004; Markovec-Černe and Dressler, 1997).

One might also add that comprehension is often seen as preceding production (though some recent research e.g., Prat-Sala and Hahn, 2007, contradicts this view), and children with specific language impairment are sensitive to number agreement errors in comprehension, but still produce them above the level of chance.

Overall, there is a great deal of evidence to suggest that the plural is marked with respect to the singular, although there are counterexamples.

### 2.1.3 *Can the markedness hypothesis explain current findings in number agreement?*

A common type of error from both corpus studies and experimental data (e.g., Bock and Miller, 1991) is a plural attraction error following a singular head and a plural local noun (SP condition), e.g.,

(189) The farmer with the cows were in the field

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<sup>3</sup>Tiersma (1982) indicates numerous counterexamples within individual items; pairs and objects which usually occur in groups which historically had different stems for singular and plural often show levelling, with the singular stem usually being the one which is generalised to the plural (Example 2) but in the case of pairs / groups, it is the plural stem which is generalised to the singular (as in Example 1), as shown in the French nouns (from Tiersma, 1982)

- (1) genouil / genoux - genou / genoux  
knee / knees - knee / knees  
'knee / knees - regularised knee / knees'
- (2) rossignol / rossignous - rossignol / rossignols  
nightingale / nightingales - nightingale / nightingales  
'nightingale / nightingales - nightingale / regularised nightingales'

As noted in Chapter 1, the opposite, a singular attraction error following a plural head and a singular local noun (PS condition), e.g.,

(190) The farmers with the cow was in the field

is much less common, at least when compared to a baseline of errors when the intervening noun is plural too (PP condition), of the type,

(191) The farmers with the cows was in the field

Eberhard and colleagues (Bock and Eberhard, 1993; Eberhard, 1997) propose that the asymmetry is due to the morphosyntactic feature markedness: singular is unmarked, while plural is marked. Eberhard (1997) defines markedness as the possession versus the lack of a property. On an activation-based account (e.g., Dell, 1986, 1988), only marked features can cause attraction errors, since they represent additionally activated features. Where there are no marked features, the default (most frequent) form will be retrieved, i.e. the singular. According to Eberhard (1997), features have higher or lower activation levels (e.g., head noun features are higher than local noun features, noun features are higher than head determiner / quantifier features). The activation of a feature on a local noun causes noise in the system. Other factors can increase the activation levels of a local noun (e.g., temporal proximity; Nicol, 1995), leading to an agreement error.

The concept of markedness can explain many results which show this asymmetry of singular and plural number values, which has been replicated many times in comprehension (Nicol et al., 1997; Pearlmutter et al., 1999) and in production in Spanish, German, Dutch, French, and English (Bock and Cutting, 1992; Bock and Eberhard, 1993; Bock and Miller, 1991; Bock et al., 1999; Fayol and Got, 1991; Fayol et al., 1994; Hartsuiker et al., 2003; Hupet et al., 1996; Thornton and MacDonald, 2003; Vigliocco and Nicol, 1998; Vigliocco et al., 1995, 1996a, and for English but not French Franck et al., 2002). The usual findings in English are exemplified in Figure 2.1 (adapted from Bock & Miller, 1991). Here, as in all subsequent charts, the  $x$  axis shows the conditions, with two values, that of the head noun and that of the local noun, given to identify each condition. For this and all subsequent charts in Chapters 2 and 3, the  $y$  axis shows only agreement errors. Agreement errors in the mismatch conditions (inner columns) are compared to random agreement errors in the match conditions (outer columns). Attraction errors may be calculated by subtracting the agreement errors in the mismatch

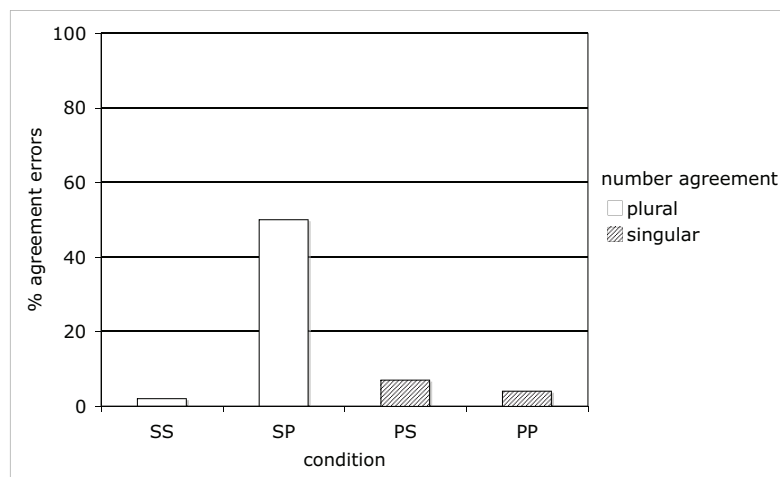


Figure 2.1: Commonly found pattern of attraction errors - plural agreement errors for singular heads and singular agreement errors for plural heads (Bock & Miller, 1991)

showing singular head, singular local noun (plural errors); singular head, plural local noun (plural errors); plural head, singular local noun (singular errors); plural head, plural local noun (singular errors)

condition (e.g., SP, singular head, plural local noun condition) from those in the related the related match condition (e.g., SS, singular head, singular local noun condition). In this chart, it is clear that there are many more plural attraction errors (with a singular head) than singular attraction errors (with a plural head).

In French, the asymmetry has not been replicated (Franck et al., 2002). It is not clear why this might be, although the lack of phonological distinction between the vast proportion of singular and plural verb and adjective forms in French may point towards an answer. (In French, written tasks are often preferred precisely because subject verb agreement errors can only be detected orthographically and not in spoken French with most verbs.) In Italian, this asymmetry has also been replicated, but it was somewhat inconclusive: although Vigliocco et al. (1995) found that under certain conditions, a plural form was more likely to be produced after a singular head noun than a singular form after a plural head noun, two experiments showed the opposite results. Italian singular nouns involve overt phonological variants - masculine *o* or feminine *a* (or ambiguous *e*), with plural being produced by replacing *o* with *i*, *a* with *e* (or *e* with *i*). Franck et al. (2006) also failed to replicate the finding in Italian. Franck et al. (2002) and Vigliocco et al. (1995) have suggested that differences may be due to the addition of a morpheme (compared to a null morpheme for the singular in the other languages mentioned above such as in English or Spanish, which form the plural by

the addition of an *s*) in the plural, since there are also feminine attraction effects found for masculine head nouns in French. Thus Italian lacks the characteristic of marked / unmarked opposition “*signe zéro*” (Greenberg, 1966).

Similarly, Franck et al. (2002) found no asymmetry in French<sup>4</sup> using a task involving two local nouns, where the number of the first and the second local noun was varied. There were more errors following (one or two) singular attractors (e.g., Example 194 - 195) than following (one or two) plural attractors (e.g., Example 192 - 193).

(192) L'ordinateur avec les programmes des expériences  
 the.SG-computer.SG with the.PL program.PL of.the.PL experiment.PL  
 'The computer with the programs of the experiments'

(193) L'ordinateur avec les programmes de l'expérience  
 the.SG-computer.SG with the.PL program.PL of the.SG  
 experiment.SG  
 'The computer with the programs of the experiments'

(194) Les ordinateurs avec le programme de l'expérience  
 the.PL computer.PL with the.SG program.SG of the.SG  
 experiment.SG  
 'The computers with the program of the experiment'

(195) Les ordinateurs avec le programme des expériences  
 the.PL computer.PL with the.SG program.SG of.the.PL experiment.PL  
 'The computers with the program of the experiments'

There was no main effect of subject number, however. In English, there were more errors following a singular head noun than a plural, and when there were singular attractors, especially after a singular first local noun (e.g., Example 195) compared to plural attractors (e.g., Example 193). Since they also found a singular attraction effect in English despite a main effect of asymmetry collapsing across conditions, their English results were not indicative of the exact pattern of asymmetry previously found in English (i.e. a plural attraction effect and no singular attraction effect), presumably due to there being two attractors.

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<sup>4</sup>It should perhaps be noted that although the *s* is orthographically represented, it is silent and plurality is only audible on (some) verbs.

Eberhard (1997) examined the effects of specifying number with quantifiers in order to test the hypothesis that the asymmetry is due to singulars being unmarked and plurals marked by asking people to produce sentences involving marked singulars (singulars prefaced with a quantifier such as *one* or *each*), as well as singular and plural forms with the determiner *the*. She found that erroneous production of plural verb forms (e.g., *The key to the cabinets are lost*) was reduced when the head noun was marked (e.g., *One key to the cabinets are lost*), and that the erroneous production of singular verbs (e.g., *The keys to the cabinet is lost*) increased when the local noun was marked (e.g., *The keys to one cabinet is lost*).

Since the singular in English is unmarked and is not overtly marked on the noun, it is unclear whether it is pure morphophonological overtness or whether it is grammatical markedness which causes the observed pattern of effects.

The singular is also unmarked in Romanian, but it can be either null or overt. Smyth & Nicolau (2000) found that these two types differ considerably, namely there were more singular errors after a singular attractor with an overt singular marker than after a singular attractor with a null marker (there were also no plural attraction errors after a singular head with an overt singular marker, but there were few errors after a singular head with a null marker), demonstrating that overtness does play a role in agreement errors independently of number markedness (at least in the case of singular local nouns). This would suggest that the lack of morphophonological marking on the singular noun in English (compared to the overt *s* marker in the plural) rather than its morphosyntax is what causes the attraction errors. This is consistent with the wealth of data (see Chapter 1) showing the effects of morphophonological form on agreement production, although it is not consistent with Bock & Eberhard's (1993) findings - they attempted to rule out the explanation of phonological overtness by comparing singular and plural homophones such as

- (196) The gardener with the hoe
- (197) The gardener with the hoes
- (198) The gardener with the hose

They found no difference between singular homophones (e.g., *hose*) of plural nouns and the singular controls (e.g., *hoe*), suggesting that it was not phonology

per se which causes attraction errors. However, this is not testing morphophonological overtness, since clearly *hose* is still singular.

Bock, Eberhard and colleagues (Bock, 2004; Bock et al., 2001; Eberhard et al., 2005) have developed a model of agreement production which they call Meaning, Marking and Morphing (MMM). In this model, there are two separate processes: marking, whereby the entire subject NP is marked with a number value, and morphing, whereby the grammatical agreement is implemented, with the number being specified on the target (verb)<sup>5</sup>. Number is represented in MMM as a continuously-valued feature, which they refer to as the Singular-and-Plural (SAP) feature. Number specification of a complex noun phrase is calculated in working memory by a spreading activation process. The feature is positive for plural NPs and zero for singular NPs. The oft-observed asymmetry is achieved because the SAP value is made up of the values of lexical constituents including the head and local nouns (differently weighted to reflect the strength of the link binding each lexical constituent to the NP node), calculated from the lexical features of the nouns. A plural head carries a positive value; coupled with zero (from a singular local noun), the SAP will be above zero, thus the outcome will not be more likely to be plural than in the match (plural local noun) condition where there are two positive values. However, a singular head carries a zero value; if the local noun is plural, the resulting feature is positive, therefore the SAP will be above zero, thus the outcome will be more likely to be plural than in the match (singular local noun) condition. Features from other elements in the noun phrase may also influence agreement, hence the effect of ambiguous determiners (Hartsuiker et al., 2003). Although MMM allows for degrees of singularity / plurality, it is ultimately assuming that the singular is unmarked and the plural marked, thus for our purposes it does not differ fundamentally from the Markedness Hypothesis.

## 2.2 Slovene number

Slovene is the ideal language in which to further investigate the role of markedness in agreement processing, since, like Spanish and Italian, it employs overt (gender-inflected) morphemes for singular nouns and, unlike Spanish but like

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<sup>5</sup>I follow Bock (2004) in her terminology - she is committed to a non-unificatory process of agreement; she refers to unification as "concord", but states that this is what happens between a pronoun and a noun phrase predicate, e.g., *she is my niece* or a pronoun or antecedent, not between pronouns and antecedents in a structural relationship.

Italian, it employs portmanteau (gender and number combined) morphemes in the plural, instead of the simple addition of a plural morpheme (e.g., *s*). In fact it resembles both English-type languages which show attraction effects (since the masculine singular nominative has null marking) and Italian-type languages which do not (since feminine and neuter singular nominative do not have null marking).

Furthermore, in binary number systems, we do not know whether people are producing an agreement error due to the local noun or a random error. Bock & Miller (1991) attempt to solve this problem by subtracting the number of random agreement errors produced in the match condition (the baseline) from the number of agreement errors produced in the mismatch condition. Attraction errors are the agreement errors which are produced after a local noun and match that local noun's features whilst not matching the features of the head noun subtracted from the number of agreement errors produced after a local noun which matches the number of the head noun (not the local noun). The asymmetry that we see in English is not due to a lack of errors after a plural head noun, but due to the fact that after a plural head noun, there are a comparable number of errors whether or not the local noun is singular, suggesting that these errors are not attraction errors (even in the mismatch condition) but are random errors. Random errors are errors which match the number of neither the head nor the local noun, but in fact, we do not know how many of the errors in the mismatch condition are due to the local noun acting as an attractor and how many are due to mere chance. Thus, in the many agreement studies which have found that there was only a plural attraction effect and no singular one, the relatively high number of agreement errors after a plural head noun (whether followed by a singular or a plural local noun) may have been obscuring the singular attraction errors. This does not explain why there are few errors in a singular match context and many errors in a plural match context, but it does suggest that the observed asymmetry in the attraction effects may in fact be something else.

As Slovene has a third number value, the dual (referring to two entities), it allows us to separate out random agreement errors (which may be mere production of a default form) from the agreement errors of interest (i.e. forms produced which actually match the local noun and cannot be deemed to be a default or indeed randomly produced). Thus, we can test whether the singular fails to cause attraction errors whilst being susceptible to them, as has been found in English.

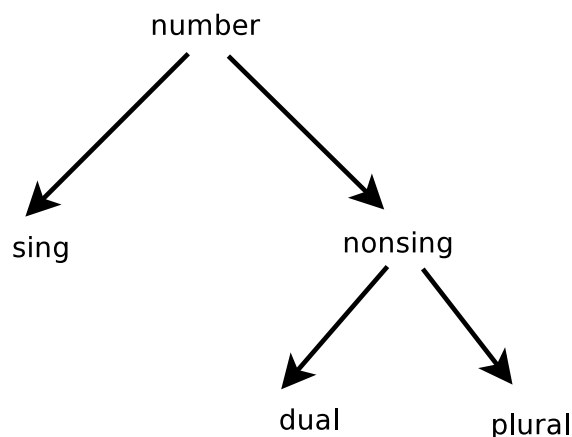


Figure 2.2: Number markedness in Slovene (adapted from Corbett, 2000)

Corbett (2000) suggests a number markedness hierarchy for languages with a three-way number marking system, singular < plural < dual. More specifically, in order to account for the facultative use of the dual in Slovene in natural pairs (the dual is only used to emphasise that “exactly two” is meant, otherwise the plural is used with pairs like *parents, feet, socks, etc.*, presumably because marking the dual on pairs would be redundant), Corbett proposes that number in Slovene consists of two binary alternants, singular versus plural (what I shall refer to as non-singular), and (within the latter), plural versus dual (see Figure 2.2).

### 2.2.1 *Is the dual marked with respect to the other numbers?*

There is a great deal of evidence to suggest that the dual is the most marked number.

The presence of distinctive dual number in a given language entails the presence of distinctive plural number, in other words, if a language has a dual and a singular, it also has a plural, but if it has a plural and a singular, it does not necessarily also have a dual (Greenberg, 1963). Furthermore, when a language has no dual, the plural is used to refer to two entities, thus the plural is the more basic form (McGinnis, 2005) (the opposite case that when a language has no plural, the dual is used, does not exist).

The dual is the least frequent form (Corbett, 2000). Within a language with a dual number, the use of the plural is always more extensive than the use of the

dual (e.g., in Hebrew, the dual form is only used for natural pairs<sup>6</sup> and is not extended to plurals, whereas the plural may be used for dual non-inherent pairs, such as brothers; nouns using both dual and plural conjugation are restricted to expressions of time and number). As stated above, whilst the plural can be used instead of the dual (for pairs) in Slovene, the dual cannot be used instead of the plural (or the singular), thus it is the least general form.

The dual is also argued to be more complex (McGinnis, 2005; Harley and Ritter, 2002), because, along with the paucal but unlike the general, singular or plural, it is both a group and restricted in number<sup>7</sup>. Battistella (1996) calls the marked element the one with greater “information commitment”, and the dual certainly provides more information than the plural (which, as noted above, can refer to two items) or the singular (which, as noted in Chapter 1, can refer to multiple elements in the case of collectives).

Synchronically, acquisition data also suggests that the dual is more marked than the plural, since it is acquired later (Petrič, 2004; Harley and Ritter, 2002). Diachronically, the fact that the dual has been lost, conflated with the plural, in numerous languages (e.g., Greek, Celtic) and is arguably in the process of being lost in others (e.g., Arabic, Hebrew) suggests that it is more marked than the singular and plural, which have remained intact.

It must be noted that the dual does not fulfil all of the criteria - for instance, though it is morphophonologically more marked than the plural in the nominative (as can be seen in Table 2.1, dative and usually also instrumental forms are longer than their plural equivalents), the concept of *signe zéro* has no place when comparing the dual and the plural - but then no one indicator is necessary for markedness. Clearly, there is a great deal of evidence to suggest that the dual is the most marked number value in a three-number system like that of Slovene.

The concept of markedness has been employed in order to explain the pattern of errors seen when exploring the phenomenon of attraction errors, usually in

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<sup>6</sup>As with the plural (Tiersma, 1982), there are a very few exceptions to this rule: local markedness constraints may dictate that the dual form is preserved at the expense of the singular, thus in Hebrew, the word for legs is *raglayim* regardless of whether one is speaking of two legs or more; similarly, *misparayim* ‘scissors’ is inherently dual but when several pairs of scissors are referred to, the form does not change to plural.

<sup>7</sup>It should be noted that there are counter-arguments to this; Cowper (2005) argues that the plural is more marked because in addition to being more than one, like the dual, it is more than two!

English or a closely-related Indo-European language. The explanation is only used to explain the error patterns seen in languages with two number values, yet many of the world's languages have more than two values. I therefore set out to investigate whether the explanation could be extended in order to account for typologically different languages, and indeed whether such a language would have a similar pattern of errors.

### 2.3 Methodology

The methodology used in this thesis is based on the most commonly used methods employed in the subject-verb agreement literature. As it differs little between experiments, it will be briefly explained here. The method is used in order to elicit subject verb agreement, and especially, in order to explore the pattern of agreement (in Experiments 1-5, agreement errors) found. The participant is presented with a (complex) subject as a preamble, and is asked to repeat this and to complete the sentence (which will necessitate the production of a verb). The subject will consist of a complex phrase including two nouns, (in Experiments 1-5) a head noun (which the verb would be expected to agree with) and a local noun, which will either have the same agreement features as the head noun (in a match condition) or different features (in a mismatch condition). In order to constrain the response and / or to distract the participant from the real purpose of the task, a completion word is often provided. The participant is presented with the completion word (if applicable), followed by the preamble, and is obliged to complete the sentence under time pressure. The time allocated for the completion of preambles was enough that at least 8 out of 10 people pre-tested could complete a similar proportion of preambles with a sentence including agreement.

### 2.4 Experiment 1: Slovene number attraction errors after relative clauses

Experiment 1 replicates simple agreement error elicitations with singular and plural nouns (e.g., Bock & Miller, 1991), using the same syntactic structure of head nouns post-modified by a prepositional phrase, since simple preambles have been shown to elicit more attraction errors than relative clause preambles (Bock & Cutting, 1992; Nicol, 1995).

The first experiment will measure the rates of agreement errors after a matching local noun (i.e. an intervening local noun with the same number value as the head noun) versus a mismatching local noun (i.e. an intervening local noun with a different number value to the head noun), e.g.,

- (199) lovec, ki sta ga gledala debela  
 hunter which AUX.DU OBJ.M.SG watch.PPL.M.DU fat.M.DU  
 kmeta  
 farmer.DU  
 'a hunter whom (two) fat farmers were watching'
- (200) lovec, ki so ga gledali debeli kmetje  
 hunter which AUX.PL OBJ.M.SG watch.PPL.M.PL fat.M.PL farmer.PL  
 'a hunter whom (three or more) fat farmers were watching'
- (201) lovca, ki ju je gledal debel  
 hunter which OBJ.M.DU AUX.M.SG watch.PPL.M.SG fat.M.SG  
 kmet  
 farmer.SG  
 '(two) hunters whom a fat farmer was watching'
- (202) lovci, ki jih je gledal debel kmet  
 hunter which OBJ.M.PL AUX.SG watch.PPL.M.SG fat.M.SG farmer.SG  
 '(three or more) hunters whom a fat farmer was watching'

The experiment crossed singular, dual and plural nouns in local position with singular, dual and plural head nouns.

Although relative clauses have been found to elicit less agreement errors than prepositional phrases (Bock & Cutting, 1992; Nicol, 1995), non-subject (non-nominative) case marking on local nouns has been shown to reduce the likelihood of them acting as attractors (Hartsuiker et al., 1999; 2001), so subject relative clauses, with nominatively case-marked local nouns, are used: they may elicit more errors in a language in which the only alternative is overt case-marking for non-subject case. I thus use relative clauses in the following experiments to avoid floor effects.

If it is the case that singulars are unmarked and non-singulars marked, then there should be a clear difference between (low) singular attraction rates and (high) non-singular attraction rates. In order to test this, I employed a three (head noun number) by three (local noun number) fully crossed design.

Cond	Sentence preamble		Translation
SS	<i>Učenec ki ga je popravil</i>	<i>učitelj</i>	'A student whom a teacher corrected'
SD	<i>Učenec ki sta ga popravila</i>	<i>učitelja</i>	'A student whom (2) teachers corrected'
SP	<i>Učenec ki so ga popravili</i>	<i>učitelji</i>	'A student whom (3+) teachers corrected'
DS	<i>Učenca ki ju je popravil</i>	<i>učitelj</i>	'(2) students whom a teacher corrected'
DD	<i>Učenca ki sta ju popravila</i>	<i>učitelja</i>	'(2) students whom (2) teachers corrected'
DP	<i>Učenca ki so ju popravili</i>	<i>učitelji</i>	'(2) students whom (3+) teachers corrected'
PS	<i>Učenci ki jih je popravil</i>	<i>učitelj</i>	'(3+) students whom a teacher corrected'
PD	<i>Učenci ki sta jih popravila</i>	<i>učitelja</i>	'(3+) students whom (2) teachers corrected'
PP	<i>Učenci ki so jih popravili</i>	<i>učitelji</i>	'(3+) students whom (3+) teachers corrected'

Table 2.2: Experiment 1 experimental item

### 2.4.1 Predictions

If Slovene works like English, then we would expect more agreement errors after a mismatching local noun than a matching local noun. If these errors are a genuine attraction effect and not just random errors caused by increased processing, then we would expect these errors to match the local noun in number.

According to Eberhard's (1997) claims about markedness, using Corbett's (2000) model of markedness for Slovene, the singular is unmarked, therefore we would expect singular head nouns to be more susceptible to attraction than non-singular heads and we would also expect singular local nouns to cause fewer attraction errors than non-singular local nouns. Assuming that there can only be one unmarked form, and that the other forms are equally marked, people should tend to produce an equal number of agreement errors after preambles with a dual or plural local noun, and equally after a dual or plural head noun; the dual and plural should not operate as attractors on each other. Alternatively, if people produce more errors the higher the number value, we would expect more attraction errors after a plural local noun and fewer errors after a plural head noun compared to the dual.

Following Eberhard's (1997) claim that alongside the tendency for marked forms to cause attraction errors, there is also a tendency for reversion to the default which is the singular, then we would expect singular random errors would be most common; conversely, we would expect that dual random errors would be less common than plural random errors (since the dual is least common and thus is least likely to be the default).

2.4.2 *Materials*

A set of 63 sentence preambles was produced, comprising a head noun post-modified by a relative clause, e.g.,

- (203) učenec, ki ga je popravil učitelj  
 student whom OBJ.M.SG AUX.SG correct.PPL.M.SG teacher  
 'A student whom a teacher corrected'

A completion verb was also devised for each sentence fragment (e.g., *ZMOTITI SE* 'to make a mistake'). There were nine versions of each sentence corresponding to the nine conditions. The feminine and neuter genders were excluded from the materials, however, since the feminine dual form tends to be replaced on the main verb with the plural in the Ljubljana dialect, thus it would not be clear whether agreement errors or mere dialectal differences were being observed, and the neuter is often entirely replaced with a masculine form, thus there would be a risk of sentence fragments being altered (coupled with the extreme suppletion in Slovene, which means, for instance, that the neuter plural form of a verb or adjective is identical to the masculine dual, and indeed the feminine singular). The experimental items are listed in Appendix B.

*Pre-test*

Prior to the experiments being carried out, the acceptability of the sentences used in the experiments, along with their completions, was assessed. I asked 27 participants from the same pool as the main study to rate the acceptability of the subject noun phrases and sentence completion fragments for the experiment. Thus, subjects were asked to rate, for example, whether, of a teacher and a student, which is more likely to make a mistake. This is important since recent work (Thornton & MacDonald, 2003) has shown a larger attraction effect if the local NP is a plausible subject for the verb. A separate group of native speakers were asked to grade the plausibility, so that items could be excluded if the subject of the sentence was unlikely to be the local noun conceptually as well as syntactically. Thus, for the above example, clearly a teacher (or teachers) can make a mistake, although a student would be a more plausible subject. There were 80 noun pairs with an associated verb each. Participants were asked to rate which noun matched the verb best on a scale of 1 (plausible with first noun) to 7 (plausible with second noun), where 4 was designated as both nouns equally

agreeing with the verb. Four examples were given (with ratings 7, 2, 4 and 5) in order to familiarise the participants with the task (given in Appendix B), e.g.,

- (204) .....pravnik.....1....2....3....4....5....6....7.....punčka  
 .....lawyer.....1....2....3....4....5....6....7.....little girl  
 .....BATISE.....  
 .....FEAR.....

Two different random orders of items was produced and each given to half of the participants. The results were as follows. Scores ranged from 1.70 to 6.63. Scores were then normalised so that head and local noun plausibility could be assessed on the same 7 point scale (clearly, head and local noun plausibility were not independent, but each was independently assessed). Experimental items were made up of only head nouns which had a score of no more than 4.11 (mean 3.20, standard deviation .74) and local nouns that had a minimum score of 3.07 mean 4.80, standard deviation .74), thus it was ensured that the local noun was at least as plausible a subject for the verb as the head noun was. Three nouns were replaced by a less colloquial synonym (*tovornjak* instead of *kamion* 'lorry' and *zločinec* instead of *kriminallec* 'criminal'), a more frequent hyponym (*lovec* 'hunter' for *krivolovec* 'smuggler') and a less frequent hypernym (*hrt* 'greyhound' for *pes* 'dog') respectively. Sixty-three sentence fragments with their completion verbs were thus chosen as experimental items, with the other 17 (local noun mean plausibility 4.14, head noun plausibility 3.86, standard deviation 1.14) used as practice items.

### 2.4.3 Participants

There were 135 participants, all students living and studying in Ljubljana, aged between 20 and 30. All declared themselves to be Slovene native speakers.

### 2.4.4 Procedure

This experiment involved the visual presentation of a complex subject noun phrase preceded by an intransitive verb. The task was to produce a sentence aloud using repeating the subject preamble and completing the sentence using the verb provided. Thus, presented with *Lovca, ku je je gledal debel kmet* '(Two

hunters whom a fat farmer was watching' preceded by *orati* 'plough', the participants would be expected to produce something like "Lovca, ki ju je gledal debel kmet, sta orala" '(Two) hunters whom a fat farmer was watching were ploughing', where the verb in the main clause (main verb and auxiliary if applicable) would both be inflected for number (and, if applicable, i.e. in the participle, gender).

The sentence preambles were presented to the participants on a laptop computer using the DMDX programme, part of the DMASTR software developed at Monash University and at the University of Arizona by K.I. Forster and J.C. Forster.

In order to explain the task whilst familiarising the participants with the laptop, a set of instructions was presented to participants via the DMDX program. They emphasised that the participants should attempt to produce a full sentence including the entire sentence preamble followed by the correctly conjugated verb form within the allotted time. Participants were allowed to ask clarification questions before the experiment began. The "warm-up" session consisted of nine practice items. If the participant failed to understand the task, they were reminded of the relevant part of the instructions before embarking on the "experiment proper" (of which the first nine items were also practice items). The presentation times were as follows: fixation point (400ms), verb (680ms), fixation point (450ms), sentence preamble (1750ms), sequence of dots gradually increasing in length until an audio warning sounded at 1700ms. Participants were told to respond before the beep in order to put them under time pressure. After each item, the participant could choose when to move on to the next item by pressing the space bar. Responses were recorded on audio cassette and were transcribed by the experimenter; two thirds of the recordings were also by a native speaker.

#### 2.4.5 Scoring

Only sentences where the preamble was correctly produced and followed by a verb inflected for number were analysed for the number produced. Repetition errors in the preamble or failure to complete the sentence (e.g., by continuing to modify the relative clause) were all counted as miscellaneous responses. Minor errors such as completion by a different verb were ignored. Gender or number errors in the preamble, or production of no tensed verb in the completion part were counted as miscellaneous. Non-miscellaneous responses were analysed for

number of completion verb. Where the number matched that of the head noun, the response was deemed correct; where the number matched that of the local noun instead, the response was deemed an agreement error. Responses were marked for number - singular, dual or plural. If two different completions were made in succession, only the first was scored (e.g., a participant might produce an agreement error and then immediately correct it, but this was still counted as an error).

#### 2.4.6 *Design and data analysis*

Each of the 135 participants was asked to complete seven preambles in each of the nine conditions formed by the orthogonal combination of the two factors, number of head noun (with three levels: singular, dual or plural) and number of local noun (with three levels: singular, dual or plural). Each of the 63 items occurred in every cell of the design and was presented to 15 participants in each condition. In order to make this series of experiments comparable with those described in the psycholinguistic literature, the analyses were performed in the same way. Namely, for each pair of number values, the attraction errors are calculated compared to a control condition of the number of errors of that type produced in that condition. This makes the present work directly comparable to work on only two number values (e.g., singular and plural, as in previous research by authors such as Bock & Miller, 1991). For the singular and plural comparison, then, the head noun (which can be singular or plural) is crossed with the match status (i.e. does the local noun match or mismatch the head noun; thus the noun can also be singular or plural). This allows us to see whether the head noun interacts with the match status in order to produce agreement errors.

The major statistical tests were performed using the number of agreement errors as the dependent variable. Only agreement errors of the type in question are analysed, thus the number of plural agreement errors after a singular head noun and a plural (mismatching) local noun are compared to the number of plural agreement errors after a singular head noun and a singular (matching) local noun. Random errors (dual agreement) are ignored except insofar as they contribute to the calculation of the proportions. For each possible comparison (singular and plural, singular and dual, dual and plural), two analyses of variance were carried out, one with participants and one with experimental items as random factor. Errors are reported as proportions of all responses involving number agreement. Planned pairwise comparisons were used to evaluate predicted

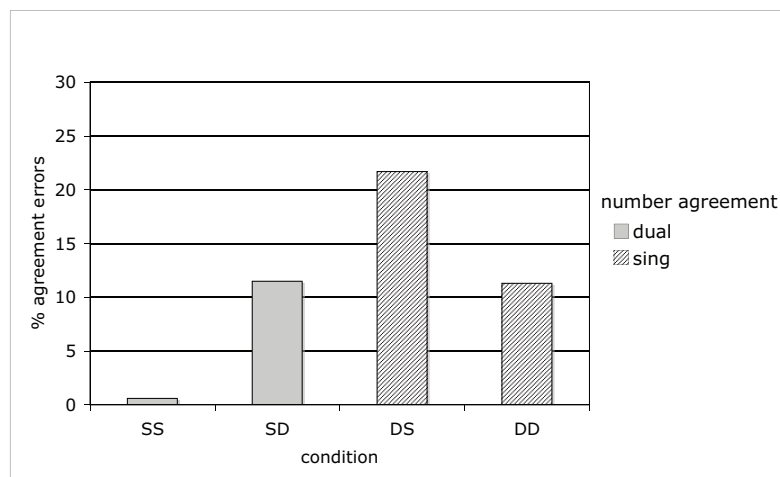


Figure 2.3: Experiment 1 - dual agreement errors for singular heads and singular agreement errors for dual heads

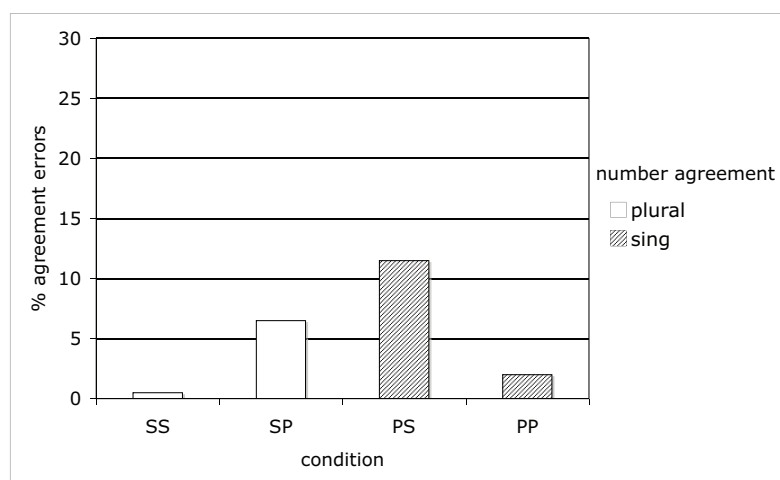


Figure 2.4: Experiment 1 - plural agreement errors for singular heads and singular agreement errors for plural heads

differences between conditions where necessary, using the mean-square error of the relevant interactions from the participants and items analyses separately.

#### 2.4.7 Results

There were 8504 responses, excluding 90 responses which were unavailable due to technical error and 135 responses which were excluded due to the item being arguably ambiguous as to gender. Of the remaining 8279 responses, 6133 were correctly repeated preambles followed by a completion which involved a verb

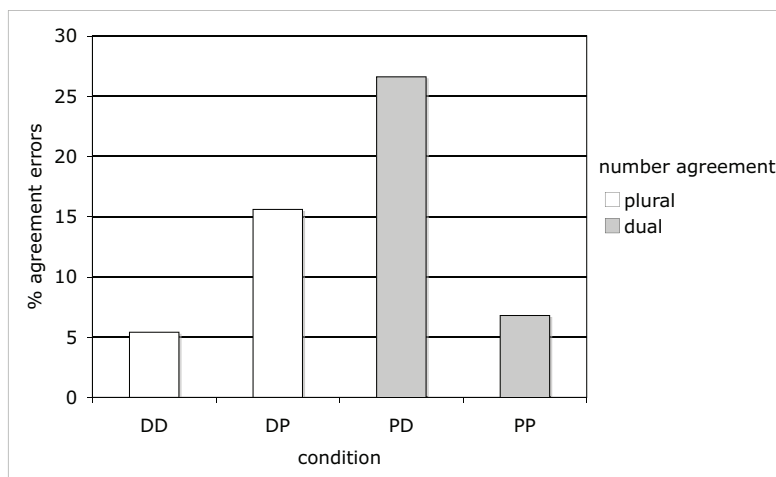


Figure 2.5: Experiment 1 - plural agreement errors for dual heads and dual agreement errors for plural heads

Response	Noun number (head noun, local noun)								
	Sing head noun			Dual head noun			Plural head noun		
Local response	Sing	Dual	Plural	Sing	Dual	Plural	Sing	Dual	Plural local
	SS	SD	SP	DS	DD	DP	PS	PD	PP
sing	764	603	632	150	71	59	80	20	14
dual	5	80	17	519	526	471	33	170	47
plur	4	10	44	21	34	98	580	449	632

Table 2.3: Experiment 1 - raw responses of all number agreement produced

showing agreement errors for singular heads (singular, dual and plural local nouns), dual heads (singular, dual and plural local nouns) and plural heads (singular, dual and plural local nouns)

unambiguously conjugated for number and could therefore be analysed as proportions of all agreement-marked responses produced in that condition. Where no response with number agreement marking was produced in a particular condition (for a participant or item), the missing proportion was replaced with the mean of that response in that condition. 45 cells were replaced in subject file, 12 in items file. Errors are shown in Figures 2.4-2.5. In order to facilitate comparison with other data in the literature, this and all subsequent charts in Chapters 2 and 3 present attraction errors, thus the  $y$  axis shows only relevant agreement errors (those with the same number (or later gender) value as the local noun in the inner columns, and the errors of the same type which were produced in the related match condition in the outer columns).

There were fewer plural errors after singular head nouns than singular errors after plural head nouns ( $F_1(1, 134) = 8.21, p = .005$ ;  $F_2(1, 61) = 9.27, p = .003$ ).

Response	Noun number (head noun, local noun)								
	SS	SD	SP	DS	DD	DP	PS	PD	PP
sing	98.8	87.0	91.2	21.7	11.3	9.4	11.5	3.1	2.0
dual	0.6	11.5	2.3	75.7	83.4	75.0	4.8	26.6	6.8
plur	0.5	1.4	6.5	3.0	5.4	15.6	83.7	70.3	91.2

Table 2.4: Experiment 1 - percentages of all number agreement produced

showing agreement errors for singular heads (singular, dual and plural local nouns), dual heads (singular, dual and plural local nouns) and plural heads (singular, dual and plural local nouns)

There were more errors after a mismatch between head and local noun than if the two nouns matched ( $F_1(1, 134) = 61.28, p < .001$ ;  $F_2(1, 61) = 81.03, p < .001$ ). There was a marginal interaction between head noun and match, with a marginally stronger singular attraction effect (PSS minus PPS = 9.5% difference) than plural attraction effect (SPP minus SSP = 6.0% difference) ( $F_1(1, 134) = 3.51, p = .063$ ;  $F_2(1, 61) = 3.43, p = .069$ ). The percentages are shown in Table 2.4 and in Figure 2.4.

As can be seen in Figure 2.3, there were fewer dual errors after singular head nouns than singular errors after dual head nouns ( $F_1(1, 134) = 31.89, p < .001$ ;  $F_2(1, 61) = 35.96, p < .001$ ). There were more errors after a mismatch between head and local noun than if the two nouns matched ( $F_1(1, 134) = 46.99, p < .001$ ;  $F_2(1, 61) = 75.88, p < .001$ ). There was no interaction between head noun and match (the attraction effects were similar in both cases: SDD minus SSD = 10.9% difference versus DSS minus DDS = 10.4% difference) (all  $F$ s < 1).

There were fewer plural errors after a dual head than dual errors after a plural head noun ( $F_1(1, 134) = 8.26, p = .005$ ;  $F_2(1, 61) = 13.18, p = .001$ ). There were more errors after a mismatch between head and local noun than if the two nouns matched ( $F_1(1, 134) = 69.31, p < .001$ ;  $F_2(1, 61) = 67.54, p < .001$ ). There was a stronger dual (PDD minus PPD = 19.8% difference) than plural (DPP minus DDP = 10.2% difference) attraction effect ( $F_1(1, 134) = 7.84, p < .01$ ;  $F_2(1, 61) = 9.51, p < .005$ ), as shown in Figure 2.5.

#### 2.4.8 Discussion

A key finding of this experiment was that the commonly-found singular-plural asymmetry has been reversed, and we find instead the singular is a stronger attractor than the plural.

The singular is susceptible to attraction as predicted, but it is also as strong an attractor as the dual or plural, which is not predicted by markedness. Finally, the dual is also a stronger attractor than the plural, which was predicted by the markedness hypothesis. The singular-singular condition is most stable, as found in previous studies.

Some of the predictions are borne out by the data. If Slovene works like English, then we would expect more agreement errors after a mismatching local noun than a matching local noun. If these errors are a genuine attraction effect and not just random errors caused by increased processing, then we would expect these errors to match the local noun in number.

According to Eberhard's (1997) claim that the singular is unmarked, we expected singular head nouns to be more susceptible to attraction than non-singular heads and singular local nouns to cause fewer attraction errors than non-singular local nouns. On the contrary, singular head nouns are less susceptible to errors than either of the other two numbers (mean correct agreement 92.3% compared to dual 78.0% and plural 81.7%). Singular local nouns cause more attraction errors than the plural and the same as the dual. This suggests that the singular is marked (or that markedness is not an explanation for the previously reported asymmetry in attraction errors between singular and plural number in English and other two-number languages).

Assuming that there can only be one unmarked form, and that the other forms are equally marked, people should tend to produce an equal number of agreement errors after preambles with a dual or plural local noun, and equally after a dual or plural head noun; the dual and plural should not operate as attractors on each other. However, there is a clear difference between the dual and plural: the dual is much more susceptible to errors and is also much more likely to cause errors on the singular. This does not fit with an explanation of more errors the higher the number value, but it does fit with an explanation stating that the dual is more marked than the plural, providing that we allow markedness to be associated with being susceptible to errors as well as causing them.

Following Eberhard's (1997) claim that alongside the tendency for marked forms to cause attraction errors, there is also a tendency for reversion to the default which is the singular, then we would expect singular random errors would be most common; conversely, we would expect that dual random errors would be less common than plural random errors (since the dual is least common and thus

is least likely to be the default). However, the results show that a simple default is not explanatory. Instead, we see that the type of random error depends on the head noun: if the head is plural, dual errors are quite common, whereas if the head is dual, singular errors are quite common; if the head is singular, there are very few random errors.

The hypothesis that the singular would not be an attractor proved to be false. It caused enormous attraction errors. Overall, as in English, the singular is the most common default, being used on the verb most commonly when there was actually no mismatch between the number of the head noun and the local noun. However, if these results are factored out, we see that the singular is not the strongest attractor. In fact, although the singular causes agreement errors, when the number produced in the baseline (same number of head and local noun) conditions was factored out, it was found that the attraction errors followed the same pattern predicted by Corbett (2000), singular < plural < dual. Furthermore, the susceptibility to agreement errors overall also followed the pattern singular < plural < dual overall and in the baseline conditions.

Overall, as in English, the singular is also the most common default. However, this is to simplify. We can clearly see that although erroneous agreement is most commonly singular, this is not always the case. More specifically, although the singular is the clear default for the dual heads, the dual appears to be the default for the plural heads. This is incompatible with an approach whereby there is a single default, and it is also incompatible with an approach wherein the frequency dictates the default - the dual is less frequent than the plural. My results therefore argue against two plausible existing accounts.

One explanation for these surprising results is that the singular is acting as default, and the dual is acting as the most marked form, but there is no reason for a singular default occurring significantly more frequently in conditions where it is the local noun than conditions where it is not. Although it is a less strong attractor than the dual, there is a significant singular attraction effect (12% compared to 7% in the match condition), and it is a relatively stronger attractor after a plural head (6% compared to 1.5% in the match condition).

In examining the agreement error patterns, it would be helpful to separate error causing from susceptibility to errors. Each number is associated with a different error rate frequency. In terms of attraction errors and general error rates, the pattern is clear: the dual form is most commonly erroneously produced, closely

followed by the singular, and then the plural is the least likely to be produced. This fails to fit with the markedness hierarchy hypothesis - we expected to see the singular associated with least errors, not the plural. The pattern is plural < singular < dual. It sits even less well with the “one” vs. “more than one” markedness hypothesis - unless we posit that the plural is the unmarked form. The pattern of susceptibility to errors also fails to fit neatly the predictions of either hypothesis. The singular should have been the most susceptible on both accounts, but was least susceptible to errors overall, and was less susceptible to attraction errors than the plural local noun. The dual head is slightly more susceptible to errors than the plural. Thus, instead the singular being susceptible and the other numbers less so, we find the converse. In terms of a hierarchy of susceptibility to errors, the pattern is singular < plural < dual, the exact opposite of what was predicted by the number hierarchy. This suggests that the properties of susceptibility to errors and error causing may work differently in agreement processing. If markedness explains the English data pattern, then we would expect the unmarked singular to be similarly susceptible to errors and yet not causing errors in Slovene. In fact, the least marked form in Slovene, the singular, causes more errors than the undeniably more marked plural, and is relatively unsusceptible to errors from the plural. This would suggest that there are other factors than markedness controlling agreement processing.

It should be noted that colloquially *jih* (the plural object clitic) is acceptable following a dual antecedent, thus it may be argued that the plural local conditions (singular-plural, dual-plural and plural-plural) contained less unambiguous plural cues than their counterparts contained dual or singular cues (i.e. the clitic *ga* in the singular local noun conditions and *ju* in the dual local noun conditions unambiguously indicate singular and dual number respectively). This could help to explain the higher incidence of dual agreement in the plural local (singular-plural, dual-plural and plural-plural) conditions. This is in line with previous findings (e.g., Hartsuiker, Antón-Méndez, & Van Zee, 2001; Hartsuiker, Schriefers, Bock, & Kikstra, 2003) where ambiguity of determiner and object pronoun increased error rates. However, there are only 19 incidences of *ju* being repeated in the preamble as *jih* and therefore classified as repetition errors, of which 7 would have been excluded for other reasons, so it seems unlikely that this would have had much of an effect.

The singular local noun conditions are distinguished from the other six conditions in terms of word order: the singular auxiliary *je* follows the object clitic

whereas the dual and plural equivalents *sta* and *so* precede it. Thus we might expect dual and plural to pattern together, but this is not the case. The different word order means that the type of relative clause (object versus subject relative) is disambiguated earlier in the singular local noun conditions, and also that in these sentence fragments, the subject and object of the sentence are introduced in the preferred order (given, new; Clark & Clark, 1978), with the previously-mentioned head noun's clitic being assigned the object role before the subject of the relative clause is introduced, whereas in the dual and plural local noun conditions, the head noun's clitic is introduced after the auxiliary and thus after the number value of the local noun is specified. This introduces an ambiguity in the match cases (i.e. reading *Učenca, ki sta* or *Učenci, ki so* one could assume that the auxiliary agrees with the head noun or to some other not-yet-introduced entity, which could cause some subsequent processing difficulties. Conversely, in the mismatch cases, there is a temporary ambiguity between an ungrammatical reading of the auxiliary as referring back to the head noun at the same point (*Učenca, ki so / Učenci, ki sta*).

It should also be noted that the form of the participle and also of the noun is syncretic. An animate noun (e.g., *prasec* 'pig') has the same form in the nominative dual as in the singular genitive, singular accusative, dual accusative, thus the singular nominative may be said to be more marked as singular, despite having zero morphophonological marking, than the dual is marked as dual. Similarly, inanimate nouns and verb participles also display syncretism; again, only the singular masculine is unambiguous, whilst the dual masculine is identical in form to the singular feminine and plural neuter forms (albeit combined with a different auxiliary form), and the plural masculine is identical in form to other forms likewise - see Table 2.5 for examples of the ambiguities for animate nouns (e.g., *prasec* 'pig'), inanimate nouns (*uhan* 'ring') and participles (from *biti* 'to be').

Experiment 1 explored the role of markedness in Slovene number agreement. Having extended Eberhard (1997)'s markedness hypothesis in order to make predictions for a language with more than two number values, I discovered that singular attraction errors occurred and that the dual caused more attraction errors than the plural, both of which suggest that the hypothesis needs extending in order to account for a wider range of data.

Singular	Dual	Plural
prasec SG NOM	prasca DU NOM / SG GEN / SG ACC / DU ACC	prasci PL NOM / PL INSTR
uhan SG NOM / SG ACC	uhana DU NOM / SG GEN DU ACC	uhani PL NOM / PL INSTR
bil SG M	bila DU M / SG F / PL N	bili PL M / DU F / DU N

Table 2.5: Slovene syncretism

## 2.5 Experiment 2: Slovene number attraction errors without relative clauses

Several researchers (Bock and Cutting, 1992; Nicol, 1995; Solomon and Pearlmutter, 2004) found different patterns of errors using nouns post-modified by relative clauses compared to those post-modified by prepositional phrases. Experiment 1 found strong singular attraction effects after non-singular head nouns post-modified by a relative clause, which differs from the usual pattern of number attraction effects (e.g., Bock & Miller, 1991). It is therefore interesting to confirm whether the same pattern of errors can be found using the type of complex NPs employed by those investigators. The second experiment set about replicating the first but employing materials designed to elicit more agreement errors by employing a noun phrase involving a prepositional phrase or genitive rather than a relative clause. It replicates simple agreement error elicitation with singular and plural nouns (e.g., Bock & Miller, 1991), using the same syntactic structure of head nouns post-modified by a prepositional phrase or a simple genitive phrase.

This experiment will measure the rates of agreement errors after a matching local noun (i.e. an intervening local noun with the same number value as the head noun) versus a mismatching local noun (i.e. an intervening local noun with a different number value to the head noun), e.g.,

- (205) Duhovnika podeželske cerkve  
 priest.DU local.SG.GEN church.SG.GEN  
 ‘The (two) priests of the local church’

The experiment crosses singular, dual and plural nouns in local position with dual and plural head nouns. Singular heads are not employed because the filler

items employed (experimental items for another experiment not reported here) had singular heads; since singular heads have already been shown to elicit agreement errors in many languages, it was not thought necessary to test them further.

A further manipulation consisted of whether the items were ambiguous (with identical form in dual and plural local noun conditions) or unique (with unambiguous forms for every number value) (see Tables 2.6 - 2.7). The task was to complete the sentence using the given verb (e.g., for the item shown in Table 2.6, *PREDATI* 'SURRENDER', for Example 205 shown in Table 2.7, *MOLITI* 'pray').

Condition	Sentence preamble	
dual-sing	<i>Ladji z vidno zastavo</i>	'The (two) ships with the distinctive flag'
dual-dual	<i>Ladji z vidnima zastavama</i>	'The (two) ships with the distinctive (two) flags'
dual-plur	<i>Ladji z vidnimi zastavami</i>	'The (two) ships with the distinctive (3+) flags'
plur-sing	<i>Ladje z vidno zastavo</i>	'The (3+) ships with the distinctive flag'
plur-dual	<i>Ladje z vidnima zastavama</i>	'The (3+) ships with the distinctive (two) flags'
plur-plur	<i>Ladje z vidnimi zastavami</i>	'The (3+) ships with the distinctive (3+) flags'

Table 2.6: Experiment 2 experimental item - unique version

Condition	Sentence preamble	
dual-sing	<i>Duhovnika podeželske cerkve</i>	'The (two) priests of the local church'
dual-dual	<i>Duhovnika podeželskih cerkev</i>	'The (two) priests of the local churches'
dual-plur	<i>Duhovnika podeželskih cerkev</i>	'The (two) priests of the local churches'
plur-sing	<i>Duhovniki podeželske cerkve</i>	'The (3+) priests of the local church'
plur-dual	<i>Duhovniki podeželskih cerkev</i>	'The (3+) priests of the local churches'
plur-plur	<i>Duhovniki podeželskih cerkev</i>	'The (3+) priests of the local churches'

Table 2.7: Experiment 2 experimental item - ambiguous version

### 2.5.1 Predictions

According to Eberhard's (1997) claims about markedness, using Corbett's (2000) model of markedness for Slovene, we can make the following predictions. The more marked the head noun, the fewer errors. Dual local nouns will elicit more attraction errors than plural local nouns since they are marked with respect to the plural. Non-singular heads will not be susceptible to agreement errors when a singular local noun intervenes, since they are marked with respect to the singular, therefore singular random errors will not differ from attraction errors. Singular local nouns will elicit fewer agreement errors than non-singular local nouns, since they are unmarked. Dual heads will be less susceptible to attraction errors,

since they are more marked than plurals. Plural heads will be more susceptible to attraction errors from dual than singular local nouns, since the former are more marked than the latter. Ambiguous (dual / plural) local nouns will result in more dual than plural errors since the dual is the most marked. Unique (dual) local nouns will result in more dual errors than ambiguous (dual / plural) local nouns since the latter are not marked as dual (i.e. are less marked)

### 2.5.2 Procedure

The procedure was as in Experiment 1. There was then a “warm-up” session of six practice items. If the participant failed to understand the task, they were reminded of the relevant part of the instructions before embarking on the “experiment proper” (of which the first six items were also practice items). The presentation followed this schema, all left-justified: fixation point (320ms), completion verb (550ms), fixation point (360ms), sentence preamble (1400ms), sequence of dots gradually increasing in length until an audio warning sounded at 1360ms.

### 2.5.3 Participants

The experiment was run in the Psychology Department of the University of Ljubljana; the 72 participants were students of that university who declared themselves to be monolingual native speakers of Slovene.

### 2.5.4 Materials

A set of experimental items (listed in Appendix C) loosely based on Bock et al.’s (1999) materials was developed, consisting of 36 head nouns post-modified by a local noun in either the genitive case (e.g., *Duhovniki podeželske cerkve* ‘Priests of a / the local church’) or in a prepositional phrase (e.g., *Ladji z vidnima zastavama* ‘(two) ships with (two) distinctive flags’). Head nouns were either dual or plural, local nouns were singular, dual or plural. Gender was controlled, with materials using nouns which were half masculine and half feminine, half matching (head and local noun) and half mismatching. Filler items consisted of 30 sentences with a singular head noun likewise post-modified by a singular, dual or plural local noun. Example items of both the ambiguous and the unique versions are shown above (Tables 2.7, 2.6).

There were two types of items, ambiguous items (where the dual and plural form is identical in genitive or locative case; results for these conditions are collapsed between dual and plural local nouns) and unique items (where the dual and plural forms differ in genitive or locative case; results for the latter only will be presented here).

It should also be noted that some items are distributive in meaning (e.g., 'the ships with the distinctive flag') whereas some were not (e.g., 'the priests from the local church'), and this has not been controlled for. However, this is the opposite structure to previous work on distributives (e.g., Vigliocco et al., 1995), where the grammatically singular entity with multiple tokens was in head position; here it is in local noun position.

#### 2.5.5 *Design and data analysis*

The analyses were as in Experiment 1.

#### 2.5.6 *Scoring*

Scoring was as in Experiment 1.

#### 2.5.7 *Results*

Overall, there were 2592 responses. Of these, 17 items (1224 responses) had unique forms for each condition, whereas 19 items (1368 responses) had ambiguous forms for the dual and plural conditions and were therefore excluded from further analysis. Of the 1224 unique responses, a further eight were excluded due to technical problems and one participant (17 responses) was excluded due to failure to complete the task. The remaining 1199 responses were correctly repeated preambles following by a completion which involved a verb unambiguously conjugated for number and could therefore be analysed as proportions of all agreement-marked responses produced in that condition. Where no response with number agreement marking was produced in a particular condition (for a participant or item), the missing proportion was replaced with the mean of that response in that condition. 57 cells were replaced in subject file, none in items file. The percentages of agreement responses produced are shown in Table 2.9.

There was a trend towards singular attraction after a dual head noun but it was not significant (all  $F$ s < 2).

Response	Noun number (head noun, local noun)					
	Dual head noun			Plural head noun		
	Sing local	Dual local	Plural local	Sing local	Dual local	Plural local
sing	9	4	3	3	3	3
dual	155	147	157	4	35	2
plur	2	7	9	170	120	164

Table 2.8: Experiment 2 - raw responses of items with unique dual and plural forms

showing agreement errors for dual heads (singular, dual and plural local nouns) and plural heads (singular, dual and plural local nouns)

	Noun number (head noun, local noun)					
	DS	DD	DP	PS	PD	PP
sing	5.4	2.5	1.8	1.7	1.9	1.8
dual	93.4	93.0	92.9	2.3	22.2	1.2
plur	1.2	4.4	5.3	96.0	75.9	97.0

Table 2.9: Experiment 2 - percentages of items with unique dual and plural forms

showing agreement errors for dual heads (singular, dual and plural local nouns) and plural heads (singular, dual and plural local nouns)

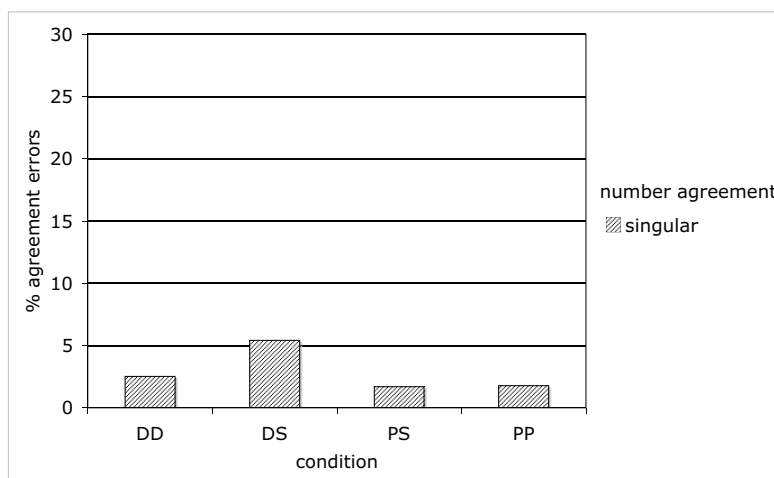


Figure 2.6: Experiment 2 - singular errors - unique items

Similarly, there was not significantly more singular agreement after a plural head and a singular local noun (1.8%) than there were random errors after a plural head and a plural local noun (0.7%) (all  $F$ s  $\leq 1$ ). There was no significant difference between the dual and plural head nouns as regards singular attraction effects (see 2.6): although there were slightly more singular errors after a dual than a plural head noun ( $F_1(1, 70) = 4.46, p < .05$ ;  $F_2(1, 16) = 5.91, p < .03$ );

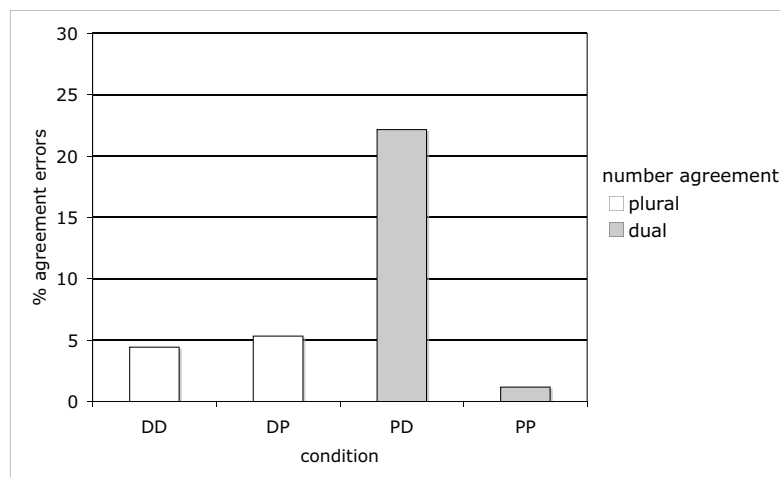


Figure 2.7: Experiment 2 - dual errors for plural heads and plural errors for dual heads - unique items

there was no effect of match ( $F_1(1, 70) \leq 1$ ;  $F_2(1, 16) = 2.03$ ,  $p > .1$ ) and crucially no interaction between head and match (all  $F$ s  $< 1$ ).

There were fewer plural errors after a dual head than dual errors after a plural head noun ( $F_1(1, 70) = 8.76$ ,  $p < .005$ ;  $F_2(1, 16) = 13.42$ ,  $p < .001$ ); there were more errors after a mismatching local noun than after a matching local noun ( $F_1(1, 70) = 22.21$ ,  $p < .001$ ;  $F_2(1, 16) = 24.60$ ,  $p < .001$ ); and there was an interaction, with a stronger dual (PDD minus PPD = 21.0% difference) than plural (DPP minus DDP = 0.9% difference) attraction effect ( $F_1(1, 70) = 24.98$ ,  $p < .001$ ;  $F_2(1, 16) = 17.26$ ,  $p < .001$ ). A simple pairwise comparison showed that there were no convincing plural attraction effects in the dual head noun condition, however: there were slightly more plural errors in the plural local noun condition (5.3%) than in the match condition (4.4%) but this was not significant (see Figure 2.7) (all  $F$ s  $< 1$ ).

By far the most striking finding, however, was the high proportion of dual attraction errors in the plural head noun condition, meaning that there were more dual errors after a plural head and a dual local noun (22.2%) than after a plural local noun (1.2%). As can be seen in Figure 2.7 and Table 2.9, there was an extremely strong dual attraction effect ( $F_1(1, 70) = 27.77$ ,  $p < .001$ ;  $F_2(1, 16) = 28.27$ ,  $p < .001$ ).

### 2.5.8 Discussion

The first experiment provided evidence for number attraction by mismatching local nouns in noun phrases involving a head noun post-modified by a relative clause in Slovene. This finding was replicated using noun phrases post-modified by a prepositional phrase in Experiment 2: there was a trend towards singular attraction after a dual head noun; there was little evidence for plural attraction, but there were strong dual attraction effects.

Experiment 1 found strong singular attraction effects after non-singular head nouns, which differs from the usual pattern of number attraction effects (e.g., Bock & Miller, 1991). Although relative clauses have been found to elicit fewer agreement errors than prepositional phrases (Bock & Cutting, 1992; Nicol, 1995), it could have been argued that these effects were due to the nature of relative clauses, thus Experiment 2 investigated whether NPs involving a relative clause and those without behaved in the same way. It was found that although the strength of the effects was reduced in the case of NPs without a relative clause, the pattern of errors was similar, thus validating the former method. Whilst previous experiments (Bock & Cutting, 1992; Nicol, 1995) found that using relative clauses reduced their effect size, in Slovene, the effects were greater with relative clauses. This difference can be attributed to case marking; in Slovene, prepositions cause their complements (in this case, the local nouns) to be case-marked for non-nominative. There is some evidence to suggest that case ambiguity can influence the agreement process (Hartsuiker et al., 2003; Schriefers & van Kampen, 1993). The weakness of the effects in Experiment 2 compared to Experiment 1 may suggest (differences in materials and power notwithstanding) that case marking on the local noun can indeed inhibit agreement error production.

Although prepositional phrase post-modifiers are most commonly used in the elicitation of attraction errors and relative clauses have been shown to elicit fewer attraction errors (Bock & Cutting, 1992; Nicol, 1995), they are more difficult to use with a highly morphologically complex language such as Slovene, since such case-marking tends to reduce the number of errors produced (Hartsuiker et al., 2003; Schriefers & van Kampen, 1993). However, this experiment has shown some evidence that markedness influences agreement similarly whether the local noun is presented in a relative clause or a prepositional phrase (as long as case marking does not disambiguate the local noun as non-nominative), namely

demonstrating that the dual is the most marked (causes the most attraction errors on the plural) whilst being more susceptible than the plural.

## 2.6 General Discussion

Dual attraction effects on the plural are significantly stronger than plural attraction effects on the dual. Singular attraction effects on the plural are marginally stronger than plural attraction effects on the singular. Dual attraction effects on the singular equal singular attraction effects on the dual. (All attraction effects are significant.)

Head nouns post-modified by a relative clause are useful (contra Bock & Cutting, 1992) for investigating agreement errors in languages with morphologically-overt case marking.

The singular attraction effects, stronger than the plural attraction effects, suggest that the idea of the singular being unmarked is wrong - according to Eberhard (1997), singular number does not have a number feature so cannot cause attraction errors (and errors should be equal in match and mismatch conditions, since they are merely due to a reversion to the default).

There is evidence for agreement in a tripartite system being influenced by relative markedness. Contrary to Eberhard (1997), the singular local noun is associated with attraction errors, and is in fact a stronger attractor than the plural. The dual is more marked than the plural, since it is associated with more errors.

However, the relationship between the number values is not as simple as might have been expected. The susceptibility and attractiveness of a particular number value appears to be dependent on which other number value is in the clause.

There seems to be more than one default number, since there are more dual errors in the plural match condition than in the singular match condition (suggesting that the dual is the default for the plural) although there are more singular errors in the dual match condition (suggesting that the singular is the default for the dual).

The results of the two experiments together provide some evidence for relative markedness dictating agreement patterns in Slovene subject verb agreement. However, whereas in earlier studies (e.g., Bock & Eberhard, 1993), singular count

nouns were shown to be entirely unmarked and were no more associated with agreement errors when in local noun position than plural count nouns, Experiment 2 showed a trend towards, and Experiment 1 showed strong evidence for, a singular attraction effect (stronger, in the plural case, than the converse plural attraction effect on a singular head noun). This suggests that singular agreement is not purely by default (Eberhard, 1997) but the singular attraction effects in Experiment 1, when compared to the random errors in the associated match conditions, were relatively low compared to the dual attraction effects, suggesting that markedness does have a role to play in agreement production. What is that role?

Why does Slovene show singular attraction effects not seen in experiments in other languages? Firstly, as noted above, it is not true that the effects have not been seen in any other language: Franck, Vigliocco & Nicol (2002) failed to replicate the singular / plural attraction distinction in French, and Vigliocco et al (1995) also found inconclusive results in Italian. Although Experiment 1 used masculine experimental items, thus emulating the English / Spanish system (i.e. adding a dual / plural marker) rather than the Italian one (having separate forms for the singular versus plural), masculine singular is the exception rather than the rule in the rich morphology of Slovene, and it would perhaps be surprising if the masculine nominative behaved like English whereas the other genders or cases behaved more like Italian. Furthermore, since, even within one language, some lexical items appear to be more marked in the plural, whereas other lexical items (e.g., *lips*) appear to be more marked in the singular (Tiersma, 1982, calls this “local markedness”; in fact, some lexical items can only appear in the plural, e.g., *trousers*), the unmarked singular seems less useful as a concept than a merely weakly marked singular. Finally, in a language such as English, experimenters have found agreement errors associated with a singular local noun, but since there are also usually agreement errors associated with a plural (matching) local noun as well, the attraction effects are just swamped in the morass of random errors. Using Slovene allows me to single out singular attraction errors by comparing error rates in another mismatch condition as well as in the match condition.

I found clear singular attraction effects which cannot be explained by Eberhard’s version of markedness, because then the singular would be unmarked and therefore could not be an attractor. It seems more sensible, therefore, to suggest that

markedness may be a matter of degree (of course, when it comes to comparing only two entities, a binary distinction can still be made). This explanation is still compatible with Eberhard's (1997) findings that adding an overt singular marker to a singular noun phrase (e.g., *one* instead of *the*) caused the singular to be a stronger attractor in local noun position or to be less susceptible to attraction in head noun position. The alternative explanation is that although the Slovene singular is just as unmarked as the English one, there was some additional singular marker present in the experimental items which allowed the singular local noun phrase to become marked and thus to be an attractor. The obvious candidate for this is the relative clause structure, which gave numerous number cues: the number was marked on the noun, adjective, auxiliary and participle (c.f. Example 206). Previous experiments (Bock & Cutting, 1992) found the same asymmetry (albeit with a reduced number of errors overall) even with relative clauses, but their materials involved only one element with (null) number marking, the noun itself (e.g., *snake* in Example 96).

- (206) hrti, ki jih je premamil živahen zajec  
 greyhound.PL which OBJ.PL AUX.SG tempted.SG lively.SG rabbit.SG  
 'Greyhounds which a lively rabbit tempted'
- (207) hrti, ki sta jih premamila živahna zajca  
 greyhound.PL which AUX.DU OBJ.PL tempted.DU lively.DU rabbit.DU  
 'Greyhounds which (two) lively rabbits tempted'
- (208) hrti, ki so jih premamili živahni zajci  
 greyhound.PL which AUX.PL OBJ.PL tempted.PL lively.PL rabbit.PL  
 'Greyhounds which (three or more) lively rabbits tempted'

This might explain why the trend of singular effects found in Experiment 2 was not significant (as in Experiment 1), although Bock & Cutting (1992) found stronger effects with an attractor contained within a prepositional phrase compared to a relative clause, however weaker plural attraction effects were also found in Experiment 2 compared to Experiment 1, suggesting that the extra word order cue was not wholly decisive.

The idea of additional cues aiding agreement for a particular NP is spelt out in the Meaning, Marking and Morphing model (Bock, 2004; Bock et al., 2001, 2004; Eberhard et al., 2005). On this account, agreement production consists of two processes, marking, which allocates the entire noun phrase an abstract number, positive for plural NPs and zero for singular NPs. However, additional singular

features may have a negative value, hence they may reduce the positive SAP and thus the possibility of plural agreement. Although in Experiments 1 and 2, the masculine adjectives were unmarked (in exactly the same way as the nouns), it is possible that the use of the unambiguously-number-marked object clitic in the Slovene relative clause construction, caused the increase in singular attraction errors observed. This reveals a tension between the additional information which can emphasise the singular feature, and the details of case (as discussed above) may conflict; more specifically, if the local noun is marked as non-nominative singular, does this cause more agreement errors because it is providing a marked singular feature, or fewer, because it is marked as non-nominative?

The second finding of note is the strong attraction effects of a dual attractor on a plural head noun (found in Experiments 1 and 2). This is what is predicted by the relative markedness of dual and plural numbers, namely that the dual is more marked than the plural (Corbett, 2000). This is again evidence for the markedness hypothesis (Bock & Eberhard, 1993; Eberhard, 1997). These findings are compatible with a singular versus non-singular distinction and within the non-singular, a plural versus dual distinction (Corbett, 2000). In this case, it is perfectly clear that the plural is not only unmarked, (in relation to the dual) but is also marked (in relation to the singular). It makes much more sense to say that the plural is less marked than the dual but more marked than the singular. What does that mean in terms of whether it carries a feature or not (as per Eberhard's model, 1997)? Eberhard's model assumes a two-value system in which one element is marked and one unmarked. This model can potentially be extended in order to account for a three- (or multiple-)valued system in (at least) two different ways.

Firstly, there could be a three- (or multiple-)valued switch instead of a binary one, such that, for instance, a number value might be marked, unmarked or negatively marked. This has to some extent been explored within the discipline which gave rise to the concept of markedness, phonology (Gnanadesikan, 1997), but by and large, it is assumed that a binary distinction is necessary. Jakobson did make it clear that binary distinctions were made between two particular elements, thus a ternary system should in principle be unnecessary. Furthermore, a ternary system would be extremely unlikely to account for a four-number system, thus a separate account would be required for different languages. The other obvious extension of a model based on markedness is to suggest that there are multiple binary switches (following Corbett, 2000). In this case, once the

model incorporates more than two number values, it is necessary for there to be two different slots for number on each noun phrase, one for the singular versus non-singular distinction and one for the dual versus plural distinction. This means that in the case of the non-singular, the plural would be expected to be the default, since there would be a clear choice between a marked dual and an unmarked plural. There should thus be more plural than singular errors following a dual head noun. It is therefore unclear why there would be so many singular errors after a dual head (whether the local noun is singular or dual). A plural would be less marked than a dual in this case, which explains the dual's higher attractor status, but not its greater vulnerability.

If the dual versus plural number slot is not marked for number after a plural head, the singular versus non-singular should still be marked with the correct value, thus the number would be more likely to come out as non-singular; if both slots are filled in the case of a dual head, it should be less vulnerable to error than the plural, and yet it is more susceptible to singular errors than the plural is. Thus it is clear that the default is not clearly the unmarked element. This will be explored further in Chapter 4. It is also apparent that susceptibility to attraction and attractiveness (or error-causing) have been conflated, whereas they appear to be two different processes. It is perfectly logical to conflate them in two-number system languages because it is not really possible to separate them, but the study of a three-number system allows investigation of these processes separately. That many natural languages have more complex number systems than English is something that would not be overlooked in theoretical linguistics, but in psycholinguistics, there is a tendency to rely on the most accessible world-dominant languages. Since we are interested in how language processing works in language, rather than in a particular language (or sub-set of languages), it is imperative that psycholinguistic methods of investigation are used in the study of languages which have other features.

## 2.7 Conclusion

I have shown how Eberhard's (1997) model needs to be extended in order to account for number systems with more than two values. Such an extension could be straightforward in principle. However, the results argue for a more complex model than any of those outlined above, with the head noun and the local noun independently influencing the number of the verb in the target. Firstly, in common with previous studies, preambles containing only singular nouns

very rarely resulted in a sentence with non-singular agreement. Unlike in earlier studies in English, erroneous singular agreement (i.e., following some combination of dual and plural head/local nouns) was extremely common. Conversely, erroneous plural agreement was relatively uncommon. This is to simplify the effects, however. Singular agreement was more common following dual head nouns than plural head nouns, with or without an intervening singular local noun (i.e. whether we count all incorrect singular responses or only those which could be termed attraction errors). Conversely, dual agreement on the main verb was more common for plural head nouns than for singular heads, with or without an intervening singular noun. Thus we can say that there is a tendency for agreement to fail in a way that results in a decrease in number, such that number decreases by one step (e.g., from plural to dual, or from dual to singular). This does not fit with any of the existing models, but could be accommodated by a model which took account of the semantics of the number value, as well as whether it is more or less marked. The problem with markedness is that although it is very useful in order to compare two items, and indeed was initially invented for that purpose, it does not do well when dealing with more complex systems, even when those systems can be thought of in terms of a series of binary switches.

I have shown that the pattern of results in a more sophisticated number system is incompatible with current models. Furthermore, the results indicate that the number of random errors is not necessarily explicable in terms of a default, suggesting that reversion to a default is a separate mechanism (this will be investigated further in Chapter 4), and further suggesting the possibility that the singular (at least the masculine singular) may have a special status conferred on it by its phonological qualities rather than its syntax. Furthermore, I have demonstrated that the notion of susceptibility is not the same as attractiveness, as, unlike in English, the number value associated with most attraction errors is not the least susceptible. Previous models have not made allowances for this. Markedness did not straightforwardly influence number agreement: although the most marked number was more likely to cause attraction errors, it was also extremely susceptible to errors. Hence it appears that the markedness cannot explain number agreement, at least not without major alterations to how agreement is measured. Exploring a complex agreement system does, however, at least allow us to separate out susceptibility from attractiveness and to investigate these two factors separately. In other words, we can see the effect of the strength of the head, as well as the effect of the strength of the local noun, without the two

being confounded by whether the two nouns match or mismatch, and without random errors swamping genuine attraction effects.

So why are certain numbers more marked than others? Clearly, these effects may be due to the numerosity of the number values, the fact that the dual is less than the singular, or they may be purely syntactic. This question can be addressed by examining the agreement patterns produced in a language such as English with no syntactic distinction between dual and plural, which is investigated next in Chapter 3.

## CHAPTER 3

### Semantic effects

#### 3.1 Introduction: Semantics in agreement

In the previous chapter, we saw that the concept of binary markedness was not enough to explain how number agreement works when it comes to a more complex system. It was suggested that the conceptual value of the number might have an effect on agreement processing. But can it do that when there is no syntactic difference? In this chapter, I set out to examine the effects of semantics on agreement processing. As stated in Chapter 1, this is an important question for a model of language production, since agreement has been argued to be a primarily syntactic phenomenon. Therefore if language production involves discrete levels of processing, the agreement process would be expected to take place at the functional level of processing (Garrett, 1988; Bock and Levelt, 1994), and the semantics of the local noun should not have any effects on agreement (over and above the prior message level effects). Broken agreement was originally claimed to be determined solely by the syntactic properties of head and local nouns (Bock and Miller, 1991). As discussed in Chapter 1, however, there is a growing body of evidence suggesting that conceptual number and gender do affect agreement. Semantic effects of distributivity (Eberhard, 1997, 1999; Hoshino et al., 2004; Nicol and Greth, 2003; Vigliocco et al., 1995, 1996a), imageability (Bock et al., 2001; Eberhard, 1999; Vigliocco et al., 1996b) effects and collectivity (Bock et al., 1999, 2001, 2004) arguably show that the semantics of the whole noun phrase, and not specifically the local noun, affect agreement. This suggests that it is the message level which drives the semantic effects rather than a process occurring at the functional level. It is therefore interesting that recent research has also shown that the plausibility of the local noun to the completion

verb also affected attraction (Thornton and MacDonald, 2003) and that likewise animacy may have an effect (Barker et al., 2000). This suggests that even after the syntactic features of the elements of the noun phrase have been computed, their semantics may influence agreement. I sought to investigate this by replicating Experiment 2 in English, a language which lacks the syntactic distinction between dual and plural number values. There were two reasons for this. In Experiment 2, I found that the dual was more susceptible to agreement errors than the plural, and that the dual also caused more errors than the plural. I therefore wanted to investigate whether the results would be comparable in a language which does not make a syntactic distinction between dual and plural (English), that is to say, to test whether or not *two* and *many* differ in number agreement. One might expect that *two*, being semantically nearer to a singular than *many*, would be associated with more singular errors; *many*, being more numerous and thus more plural, should be associated with more plural errors. Alternatively, if agreement is purely syntactic, one might expect *two* and *many* not to differ, since both are plural quantifiers in English.

A second aim was to test predictions from Bock's (2004; Bock et al., 2001) Meaning, Marking and Morphing (MMM) theory. Experiments 1 and 2 exploited Slovene's three-way number distinction to address the question of markedness, and found that although Corbett's markedness hierarchy (singular < plural < dual) accounted for more of the Slovenian data, any account of attraction effects needed to treat head and local nouns separately, namely by assessing both susceptibility and attractiveness. Bock's theory suggests a way of treating head and local noun separately, but it depends on the semantics of only the head and not the local noun being available to the agreement process. I set out to test this in Experiments 3 and 4.

Furthermore, some work has suggested that second language speakers may be sensitive to conceptual effects in agreement processing (Hoshino et al., 2004; Nicol and Greth, 2003), Experiment 4 had a further aim of testing non-native Slovene speakers of English in order to investigate their sensitivity to conceptual number and also to test whether any effects would be enhanced by the influence of their first language (this is discussed in detail below).

### 3.1.1 *Meaning, Marking and Morphing*

One candidate theory for treating the head and the local noun separately is Bock and colleagues' Marking and Morphing theory (2001, 2004), later further defined and renamed Meaning, Marking and Morphing (Bock, 2004; Bock et al., 2001; Eberhard et al., 2005). This model has been described in detail in Chapter 2 with regard to its relevance to markedness, but I am now going to concentrate on its treatment of semantic information. On this account, the computation of agreement involves two separate processes: marking, which can make reference to semantics, and which marks the entire noun phrase with an abstract number (or gender, or person, or any other agreement) value; and morphing, a device which cannot refer to semantics, and which implements grammatical agreement, the controller specifying the form of its number (or other agreement feature) on a particular target (e.g., a verb). According to Eberhard, Bock and colleagues, the notional number of a head noun can influence the final agreement, whereas on the grammatical number of a local noun can. For instance, although no effects of collectivity of local noun were found on the production of erroneous plurals after sentences like *The record of the team / player / players* (Bock and Eberhard, 1993; Bock et al., 2001), collective head nouns (*The team / player / players with the contracts*) were associated with a higher rate of plural attraction errors (Bock et al., 2004, 1999). The Singular-and-Plural or SAP value is made up of the values of constituents within (or even outside) the subject NP, which are differently weighted to reflect the strength of the link binding each lexical constituent to the NP node. For instance, a collective head noun, although grammatically singular, would contribute a lower value than a non-collective head noun, but both would be positive values. At this stage, conceptual features can influence the SAP value. The number is then transferred to the target by the process of morphing. It is at this stage that agreement errors may occur by means of interference of a local noun or, for instance, if the SAP value is not particularly high, singular agreement (i.e. reversion to the default number value) may result. Crucially, the interference of a local noun is not dependent on its semantics, as its interference can only take place during morphing, which is not sensitive to semantics.

As discussed in Chapter 2, attraction effects, where speakers erroneously make a verb agree with an intervening (local) noun rather than with the subject head noun, are well established with plural local nouns. In the last chapter, I established that the markedness hierarchy proposed by Corbett (2000) singular < plu-

ral < dual was loosely correct, but that existing models failed to account for a three-way number system.

In English, there are only occasional remnants of the distinction between dual and plural (e.g., in lexical items like “both” and in structures like “neither ... nor”), but no systematic syntactic distinction. We can identify three possible classes of model in order to explain agreement processing, all of which have different predictions about the role of semantics.

Some accounts assume that attraction errors reflect syntactic influences exclusively. Under those accounts, because the distinction between *two* and *many* is semantically but not syntactically encoded in English, this distinction should not affect attraction error rates.

Alternatively, we can suggest that semantics do come into play. This explains findings such as the effect of biological gender on agreement in grammatical gender languages like French (a feminine noun e.g., *la victime* is more likely to control masculine agreement when preceded by a context introducing a male than a female victim) (Vigliocco & Franck, 2001).

Another possibility is that semantics come into play under restricted circumstances. MMM predicts that because the distinction between *two* and *many* is semantically but not syntactically encoded in English, this distinction should affect marking but not morphing, hence it should affect the susceptibility to error of a head noun, but not the attractiveness (with respect to erroneous agreement) of a local noun.

### 3.2 Experiment 3: English number attraction errors

Having found in Experiments 1 and 2 that the dual was more susceptible to agreement errors than the plural, and that the dual also caused more errors than the plural, I wanted to investigate whether these apparently syntactic effects would be also apparent in a language which does not make a syntactic distinction between dual and plural (English). I therefore set out to test whether the pseudo-dual (a plural with the quantifier *two*) differed in number agreement to the (more starkly) plural (a plural with the quantifier *many*). The Experiment 3 emulated the syntactic 3-way number distinction of Slovene within the 2-way English system by marking plurals with the semantically distinctive quantifiers,

*two* and *many*. In this way it was possible to test the predictions of the three possible models outlined above.

### 3.2.1 Predictions

As stated above, it is unclear to what extent semantics can be used in agreement processing. Following the results of the previous two experiments coupled with the extensive work on English attraction errors in the previous literature (e.g., Bock and Miller, 1991), I expected the following. First, if I succeed in replicating previous work, then there should be more attraction errors after singular than plural head and fewer attraction errors after singular than plural local noun. If agreement is entirely syntactic, then there should be no semantic difference between *two* and *many* conditions, thus plural local nouns (*two* and *many*) will elicit attraction errors equally. If semantic information is always available (i.e. semantic interference on heads and local nouns), then pseudo-dual *two* heads will be more susceptible to attraction errors; *many* heads are semantically more plural so will be less susceptible to singular attraction errors than *two* heads; singular heads will be more susceptible to attraction from *many* than *two* local nouns. Finally, if semantic input is restricted to the head noun (as in MMM), *two* heads will be more susceptible to errors than *many* heads but singular heads will be equally susceptible to attraction from *two* or *many* local nouns.

Since we were using translation-equivalent materials translated from Slovene, the indefinite article was used in English. Most previous experiments have used the number-neutral *the*. As discussed in Chapter 1, Eberhard (1997) found that replacing *the* with number-marked words like *one* or *each* caused more singular errors in local noun position (e.g., Example 113) and fewer plural errors in head position (e.g., Example 109). This necessarily means that we predict more attraction errors than in previous English experiments, however, we still predict fewer singular attraction errors than plural attraction errors.

### 3.2.2 Method

#### *Procedure*

To test this hypothesis, speakers performed a sentence completion task. The procedure was as for experiment 1, except that it was carried out in E-prime. The presentation times were as follows: fixation point (400ms), verb (680ms), fixation

Condition	Sentence preamble				Key word
sing	A bull		a proud matador has		
dual	Two bulls	which	two proud matadors have	skewered	disabled
plural	Many bulls		many proud matadors have		

point (450ms), sentence preamble (1750ms), sequence of dots gradually increasing in length until an audio warning sounded at 1700ms.

### *Materials*

Materials were translation-equivalents of the 63 items employed in Experiment 2, consisting of a preamble (a complex NP containing a head noun and a post-modifying relative clause), but in order to elicit a number-marked verb, it was necessary that they were paired with a key word which was either an adjective or a gerund form<sup>1</sup>. Although there is no article in Slovene, thus most of the materials were ambiguous between definite and indefinite, it is possible to mark definiteness on singular masculine adjectives, and the singular local nouns in Experiment 2 were indefinite, so the indefinite article was used throughout in English. The materials are listed in Appendix D. To emulate the three-way number system in Slovene, plural nouns were quantified with either *two* or *many*. The three number conditions (“a” / “an”, *two* and *many*) of the head and local noun were crossed, yielding 9 different conditions. Match conditions are shown below.

### *Participants*

There were 99 participants (26 male, 73 female), all students living and studying in Edinburgh, with an average age of 21.7. All declared themselves to be English native speakers.

### *Scoring*

Scoring was as in the previous experiments.

<sup>1</sup>Following Antón-Méndez et al. (2002), who found that the agreement process was unitary (one process) whether agreement was with an adjectival or a verbal predicate. Note that many other experiments have employed an adjective as a completion word (e.g., Barker et al., 2001; Haskell & MacDonald, 2005; Vigliocco & Nicol, 1998).

### 3.2.3 Design and data analysis

As in Experiment 2, each of the 99 participants were asked to complete seven preambles in each of the nine conditions formed by the orthogonal combination of the two factors, number of head noun (with three levels: singular, dual or plural) and number of local noun (with three levels: singular, dual or plural). Each of the 63 items occurred in every cell of the design and was presented to eleven participants in each condition. The major statistical tests were performed using the number of agreement errors as the dependent variable. Two analyses of variance were carried out, one with participants and one with experimental items as random factor. All effects that are reported as significant achieved significance at the .05 level or beyond. Errors are reported as proportions of all agreement to facilitate comparison between experiments. Planned pairwise comparisons were used to evaluate predicted differences between conditions, using the mean-square error of the relevant interactions from the participants and items analyses separately. Further, the results of Experiment 3 were analysed with those of Experiment 2, with experimental language (Slovene or English) as a between-groups factor. Since the responses in Slovene could be dual or plural, whereas in English, they could only be plural, results were analysed in terms of singular versus non-singular.

### 3.2.4 Results

There were 6237 responses, excluding 32 responses which were unavailable due to technical error. Five items were excluded altogether from the analysis due to experimenter error. Of the remaining 5710 responses, 3773 were correctly repeated preambles followed by a completion which involved a verb unambiguously conjugated for number and could therefore be analysed as proportions of all agreement-marked responses produced in that condition. Where no response with number agreement marking was produced in a particular condition (for a participant or item), the missing proportion was replaced with the mean of that response in that condition. 36 cells were replaced in the subject file, and two were replaced in the items file. The percentages of agreement responses produced are shown in Table 3.2.

We can look first at the most commonly studied set, singular and plural. When the plural was conceptually more plural, using the quantifier *many*, there were more plural agreement errors after a singular head followed by a plural (6.5%)

Response	Singular head noun			<i>two</i> head noun			<i>many</i> head noun		
Local	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>
singular	462	376	407	74	44	40	44	24	23
plural	8	67	37	364	364	349	404	373	313

Table 3.1: Experiment 3 (native speakers of English) - raw responses of all agreement produced

showing agreement errors for singular heads (singular, *two* and *many* local nouns), *two* heads (singular, *two* and *many* local nouns) and plural heads (singular, *two* and *many* local nouns)

Response	Singular head noun			<i>two</i> head noun			<i>many</i> head noun		
Local	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>
singular	98.3	84.9	91.7	16.9	10.8	10.3	9.8	6.0	6.8
plural	1.7	15.1	8.3	83.1	89.2	89.7	90.2	94.0	93.2

Table 3.2: Experiment 3 (native speakers of English) - percentages of all agreement produced

than a singular head followed by a singular local noun (1.6%), thus I found a plural attraction effect of 4.9%. There were also more singular agreement errors after a plural head followed by a singular local noun (7.7%) than a plural local noun (7.1%), thus the singular attraction effect after a plural head noun with the quantifier *many* was 0.6% (see Figure 3.1). There was no effect of head noun by participants although there was by items ( $F_1(1, 98) = 2.52, p > .1$ ;  $F_2(1, 57) = 7.24, p < .01$ ); and an effect of match versus mismatch of head and local noun ( $F_1(1, 98) = 18.60, p < .001$ ;  $F_2(1, 57) = 13.64, p < .001$ ); but therefore no asymmetry ( $F_1(1, 98) = 2.03, p > .1$ ;  $F_2(1, 57) = 1.78, p = .424$ ) for singular versus plural attraction errors where the plurals involved the quantifier *many*. There were, however, significant attraction effects with a singular head ( $F_1(1, 98) = 17.18, p < .001$ ;  $F_2(1, 57) = 16.79, p < .001$ ); and marginal effects with a plural head ( $F_1(1, 98) = 3.50, p = .064$ ;  $F_2(1, 57) = 2.04, p > .1$ ).

When the plural was conceptually less plural, using the quantifier *two* to make a pseudo-dual, there were likewise more plural agreement errors after a singular head followed by a pseudo-dual (13.0%) than a singular head followed by a singular local noun (1.6%), thus I found a plural attraction effect of 11.4%. There were also more singular agreement errors after a pseudo-dual head followed by a singular local noun (15.1%) than a pseudo-dual local noun (8.9%), thus the singular attraction effect after a plural head noun with the quantifier *two* was 6.2% (see 3.2). A 2\*2 (head\*match) ANOVA with singular and plural errors as the dependent variable revealed an effect of singular versus pseudo-dual head ( $F_1(1,$

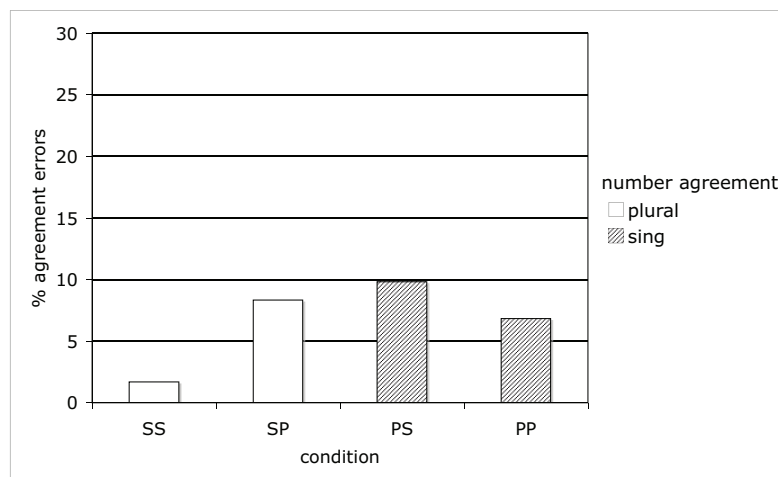


Figure 3.1: Experiment 3 - plural agreement errors for singular heads and singular agreement errors for plural *many* heads - L1 speakers

agreement errors for the singular head (singular, *many* plural local noun) conditions and the plural *many* head (singular, *many* plural local noun)

98) = 6.34,  $p < .02$ ;  $F_2(1, 57) = 5.94$ ,  $p < .02$ ); an effect of match versus mismatch between head and local noun ( $F_1(1, 98) = 29.42$ ,  $p < .001$ ;  $F_2(1, 57) = 31.45$ ,  $p < .001$ ); and an interaction ( $F_1(1, 98) = 6.85$ ,  $p < .02$ );  $F_2(1, 57) = 6.97$ ,  $p < .02$ ) for singular versus plural attraction errors where the plurals involved the quantifier *two*. with a singular head ( $F_1(1, 98) = 36.38$ ,  $p < .001$ ;  $F_2(1, 57) = 39.45$ ,  $p < .001$ ); and marginal effects with a dual head ( $F_1(1, 98) = 5.85$ ,  $p < .02$ ;  $F_2(1, 57) = 6.82$ ,  $p < .001$ ).

The two non-singular number values appeared to differ in their relation to the singular. There were more plural attraction errors<sup>2</sup> after the pseudo-dual (*two*) than after the conceptually-larger plural (*many*) local noun when the head was singular ( $F_1(1, 98) = 9.85$ ,  $p = .02$ ;  $F_2(1, 57) = 10.01$ ,  $p = .002$ ). Whilst the number of the local noun made no difference to the number of random singular errors produced after a dual head noun (all  $F$ s  $< 1$ ) or a *many* head noun (all  $F$ s  $< 1$ ), there slightly were more singular random errors after a pseudo-dual than a *many* head noun when the local noun involved *many* ( $F_1(1, 98) = 5.12$ ,  $p < .03$ ;  $F_2(1, 57) = 3.62$ ,  $p = .062$ ) and likewise when the local noun involved *two* ( $F_1(1, 98) = 4.43$ ,  $p < .05$ ;  $F_2(1, 57) = 4.51$ ,  $p < .05$ ), and there were more singular

<sup>2</sup>Usually, attraction errors are calculated as the number of agreement errors in the match condition compared to the number of the same type of error in the mismatch or control condition, but since *two* and *many* are both plural, the baseline in the singular match condition of plural errors is the same in both cases, thus it is possible to compare the two plural conditions directly with each other.

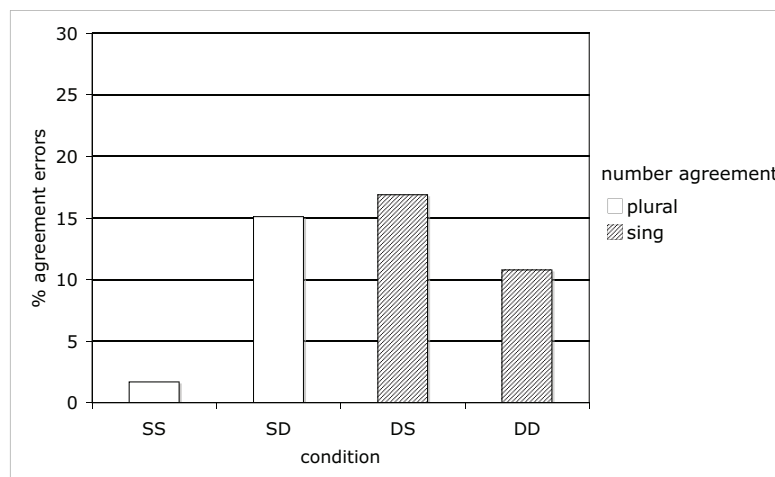


Figure 3.2: Experiment 3 - plural agreement errors for singular heads and singular agreement errors for plural *two* heads - L1 speakers

agreement errors for the singular head (singular, *two* plural local noun) conditions and the plural *two* head (singular, *two* plural local noun)

attraction errors after the pseudo-dual (*two*) than after the conceptually-larger plural (*many*) head ( $F_1(1, 98) = 7.78, p < .01$ ;  $F_2(1, 57) = 9.78, p = .003$ ), an ANOVA reveals that despite a significant effect of head ( $F_1(1, 98) = 10.44, p = .02$ ;  $F_2(1, 57) = 12.21, p = .001$ ) and match ( $F_1(1, 98) = 9.92, p = .001$ ;  $F_2(1, 57) = 8.82, p < .005$ ), there was no interaction ( $F_1(1, 98) > 1$ ;  $F_2(1, 57) = 1.02, p > .1$ ).

### 3.2.5 Discussion

In common with previous findings but unlike in Slovene, the attraction effect is stronger after a singular than a plural head noun, despite the singular number marking on the determiner.

As discussed above (Chapter 1), the singular is not usually a strong attractor in English. The commonly-found pattern of results involves little or no difference between random singular errors (after a plural local noun) and singular attraction errors (after a singular attractor). I do find strong singular attraction effects, however. The fact that I find significant attraction effects with singular local nouns after a plural head may be due to use of the indefinite article (*a, an*), since Eberhard (1997) also found singular attraction effects after quantifiers like *one* and *each*. If the singular is unmarked, as she suggests, then the extra feature (an indefinite article or a quantifier) marked for singularity could result in (more) errors.

As predicted by a model including some semantic influence, there was significantly more erroneously-produced singular agreement after *two* compared to *many* heads because *two* is semantically closer to a singular than *many* is.

As expected, there was little difference between the *two* and *many* local noun conditions after *two* or *many* heads. There was, however, an unexpected difference between *two* and *many* local noun conditions after a singular head noun.

In head position, the smaller number value *two* is associated with more singular attraction errors than the more plural *many*. It is unlikely that this is simply due to *two* being problematic, since, unlike in Slovene, the error rates after a plural head noun do not vary between the *two* and *many* local conditions. It has been suggested (Todd Haskell - pc) that the use of *two* emphasises the individuals more than *many*, thus, analogous to results such as those found by Humphreys and Bock (2005) that structures emphasising a collective reading (e.g., *the gang near the motorcycles*) were associated with more singular agreement than those emphasising a distributive reading (e.g., *the gang on the motorcycles*). Interestingly, whilst the results for collectives was arguably a conceptual meaning relating to the entire NP, my manipulation relates to the lexical semantics of the individual word, since a singular local noun could not have a distributive meaning, thus it would still be problematic for MMM. In local position, lack of difference between the plural local nouns after a plural head modified by either *two* or *many* suggests that semantic information does not influence the rate of random errors (although clearly it is only possible to measure the rate of singular versus plural agreement made in English, since the erroneous agreement with *two* vs. *many* will not show up).

These results provide some support for the MMM theory, specifically the claim that the same semantic information is available to aid normal agreement control (marking); but where there is a grammatical mismatch between the head and local noun, it appears that the information is somehow available. Although I found a robust singular attraction effect, suggesting that the singular cannot be entirely unmarked, but must be merely less marked, I still replicate the well-documented finding of asymmetry between singular and plural from the literature. More specifically, I replicate the asymmetry between the singular and plural only when the plural is marked with the quantifier *many*; when the plural is marked with the quantifier *two*, the singular attraction effect is very strong (although not as strong as the plural attraction effect).

These results are consistent with the idea that semantic differences do affect agreement production in some circumstances. A smaller number value *two* is associated with more singular attraction errors than the more plural *many*. It is unlikely that this is simply due to *two* being problematic, since, unlike in Slovene, the error rates after a plural head noun do not vary between the *two* and *many* local conditions. The lack of difference between the plural local nouns coupled with the difference between the plural head nouns provides some support for the claim that the same semantic information is available to aid normal agreement control (morphing) but unable to affect error rates in the local noun position (marking). However, one result is potentially problematic for MMM. Although there are no differences between *two* and *many* local noun conditions in syntactic match conditions (i.e. with a plural head), where there is a syntactic mismatch between the head and local noun (i.e. with a singular head), I found more plural errors after a *two* local noun than after a *many* local noun, in contradiction to my prediction of more plural errors after the more plural *many* than after the numerically less numerous *two*. This difference can only be explained by the differing quantifiers.

Since the difference goes in the opposite direction to what was predicted, however, it may not be due to the semantics of the local noun. It could be due to lexical frequency: if the word *two* were less frequent than *many*, that could explain why there are more plural errors after *two*. However, the word *two* occurs 124,925 times in the British National Corpus, whereas *many* occurs 81,961 times<sup>3</sup>, suggesting frequency is not an adequate explanation.

Thus our results support a model in which the semantics of the local noun as well as the head noun are available in the production of number agreement, at least when there is a grammatical mismatch between head and local nouns.

Another possible explanation of this pattern of results is suggested by research into quantified NP processing. Although it is standardly assumed that referential NPs are easier to process than quantified NPs, since the former picks out one specific referent, whereas the latter expresses a relation between two sets, Warren (2003) has shown that so-called “light quantifiers” (including phrases like *many cats*) are easier to process than “contentful” ones (including phrases like *every cat*) (shown by reduced reading times). Referential noun phrases (e.g., *two cats*)

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<sup>3</sup>Google gives similar results: 3,790,000,000 for *two* and 3,480,000,000 for *many*.

are similarly easy to process in main clauses but as hard to process as “contentful” ones in relative clauses. On the basis of this, I would expect that *many cats* would be less error-causing as a local noun than *two cats*, although *many cats* is more complex and semantically more plural, because *two cats* is “heavier”. This is indeed the case. Conversely, *many cats* should not differ from *two cats* in head position. I found that this was inconsistent with the results, however, as there were more singular errors after *two* than *many cats* in head position.

A simpler explanation of the current pattern of results is that *two* is more marked than *many* not only in a language like Slovene where this is a syntactic difference, but also in English where the difference is purely semantic.

Overall, this experiment extends previous research by providing support for a model of agreement processing which is neither purely syntactic nor simply based on the semantics of the number values involved. There seems to be a potential role for markedness, but as in the previous chapter, it is necessary to separate susceptibility to attraction errors from potential for causing them: number values that are marked with respect to error susceptibility are not necessarily marked with respect to attractiveness.

### 3.3 Experiment 4: English L2 number attraction errors

In the Experiment 3 we found that there was a difference between *two* and *many* even for speakers of a language with no syntactic distinction between these two number values. If second language syntax is influenced by the syntax of a speaker’s first language, as has been suggested then because Slovene makes a syntactic distinction between two and many in the form of the dual, we might expect a native speaker of Slovene to make a more pronounced difference between phrases using the quantifiers *two* and *many* than native English speakers.

#### 3.3.1 Evidence for L1 syntax influencing L2 syntax

Persuasive evidence of L1 syntax influencing L2 comes from work on syntactic priming: after hearing a Spanish passive (e.g., Example 209) rather than an active (e.g., Example 210), a participant would be more likely to produce an English passive (rather than an active) structure to describe a picture (Hartsuiker et al., 2004) and a participant would be more likely to produce an English prepositional object rather than a dative object after hearing a prime like Example 211 (rather

than its dative object equivalent Example 212) in their native Dutch (Schoonbaert et al., 2004).

- (209) el camión es perseguido por el taxi  
 the lorry is followed by the taxi  
 ‘The lorry is being followed by the taxi’
- (210) el taxi persigue el camión  
 the taxi follows the lorry  
 ‘The taxi is following the lorry’
- (211) de kok geeft een geweer aan de bokser  
 the cook gives a gun to the boxer  
 ‘The cook gives a gun to the boxer’
- (212) de kok geeft de bokser een geweer  
 the cook gives the boxer a gun  
 ‘The cook gives the boxer a gun’

There is evidence, however, suggesting that the peculiarities of one’s first language may not affect one’s second language: Sorace and Filiaci (2006) found that apparent influences of (non-pro-drop) L1 preferences in anaphoric resolution in English near-native speakers of Italian were not likely to be caused by the L1 itself, since speakers with a pro-drop L1 had the same preferences, and even native speakers under pressure of limited working memory resources exhibit non-pro-drop-like preferences.

### 3.3.2 Evidence for L1 syntax influencing L2 agreement

Previous work on L2 subject-verb agreement is inconclusive as to whether agreement processing differs cross-linguistically.

Lee (2002) found that attraction error rates in L2 speakers of English differed between Spanish and Chinese native speakers and attributed this to the difference in the syntax of the native languages. He tested advanced Chinese and Spanish learners of English in their L2 (Chinese does not have subject verb number agreement but Spanish does). Participants were screened to ensure that they were capable of producing correct subject-verb agreement in English. The commonly-found singular/plural asymmetry (e.g., Bock and Miller, 1991) was replicated by the Spanish participants, but not by the Chinese participants, who produced comparable singular and plural attraction errors. These results are compatible

with the participants using their L1 processing system to compute L2 agreement (in the Chinese case, erroneously).

Hoshino (2003) also found that the native language syntax influenced subject-verb agreement in an L2. They tested Japanese and Spanish learners of English (Japanese does not have subject verb number agreement, although as we saw in Chapter 1 it does have politeness markers, whereas the properties of Spanish morphosyntax are similar to those of English). They found that Japanese speakers were not as sensitive to semantics in agreement processing as Spanish speakers, suggesting that sensitivity to conceptual information is modulated by the speaker's L1 along with proficiency in the second language. They proposed that if the absence of a "rule" for subject-verb agreement in the L1 affects performance in the L2, then their participants could fail to demonstrate sensitivity to conceptual number. They found that highly proficient Japanese speakers of English were not as sensitive to the conceptual number in their L2 English as their Spanish counterparts. Hoshino (2003) suggest two possible explanations for their results: that L1 structure affects L2 agreement, or that the differences between (Japanese) L1 and (English) L2 structure cause processing difficulties, resulting in an increase in agreement errors. This would suggest that it is not L1 influencing L2 at all.

Nicol et al. (2001) examined late (native English-speaking) learners of L2 Spanish and early (native Spanish-speaking) learners of L2 English. They found that the Spanish speakers of L2 English were sensitive to distributivity, producing more agreement errors after preambles like 213 compared to preambles like 214.

(213) The label on the bottles

(214) The bridge to the islands

Conversely, the English speakers of L2 Spanish were not sensitive to the conceptual differences between the distributive and non-distributive materials. They explain their data (along with the monolingual data in the literature) in terms of the participants' exposure to certain syntactic structures (e.g., pro-drop, subject-verb inversion, subject-adjective predicate agreement). Their results suggest that exposure to subject-verb agreement in one's L2 can affect the computation of subject-verb agreement in one's L1.

Nicol and Greth (2003) found that semantic influences, said to differ in their effects cross-linguistically, did not actually show up in the results of native speakers of Spanish tested in their L1 and L2. They tested late learners who had achieved advanced proficiency in Spanish both in English (L1) and Spanish (L2). Although Vigliocco et al. (1996a) had previously found that Spanish (native) speakers were more sensitive to semantics (distributivity) in agreement (producing more erroneous plurals after preambles like 102 compared to preambles like 103, Nicol and Greth (2003) found no such language differences. In fact, participants showed the same level of sensitivity to semantics in both languages. They interpreted these results to mean that native speakers use the strategies of their native language to compute agreement (i.e. English speakers, who are not reliant on semantic factors in their L1, do not use them in their L2, whereas native Spanish speakers do use them).

Similarly, Hoshino et al. (2004) found that semantic effects were present in the L1 and L2 of Spanish-English bilinguals, but they attributed differences in their data and that of Nicol et al. (2001); Nicol and Greth (2003), not to language-specific variation, but to competence (in L2) or in cognitive resources (like working memory load and reading span). This follows work by Hartsuiker et al. (1999); Hartsuiker and Barkhuysen (2006) which shows somewhat conflicting results regarding the effects of limitations of computational resources on agreement processing. Hoshino et al. (2004) tested English monolinguals, showing that individual differences in reading span and verbal fluency modulated sensitivity to distributivity. They went on to test English-Spanish and Spanish-English bilinguals in both L1 and L2. They found that sensitivity to conceptual number depended, not on L1, but on level of proficiency in L2.

Alternatively, the Markedness Differential Hypothesis (Eckman, 1977) predicts that unmarked L1 features in L1 are more likely to transfer to L2, whereas marked features in L1 (such as dual number) will not transfer. This brings up the question raised in the previous chapter about whether markedness can be seen as a binary feature.

### 3.3.3 Predictions

As per Experiment 3, there should be a difference between *two* and *many* in both head position and local noun position. Additionally, if L1 affects L2, then differences between *two* and *many* should be greater, in both head and local noun

position. Alternatively, according to the Markedness Differential Hypothesis, marked L1 features (such as dual versus plural number) would not transfer to the L2, thus we would not expect to see any additional difference between *two* and *many*.

### 3.3.4 Method

#### *Procedure*

The procedure was as in experiment 3, except that the stimuli were presented in DMDX (the DMASTR software developed at Monash University and at the University of Arizona by K.I. Forster and J.C. Forster) rather than E-prime, and participants were given more time. The presentation times were as follows: fixation point (400ms), key word (800ms), fixation point (450ms), sentence preamble (2500ms), sequence of dots gradually increasing in length until an audio warning sounded at 2760ms (i.e. increased at the key word, the preamble and the beep, by a total of 1930ms).

#### *Participants*

The experiment was run in the Psychology Department of the University of Ljubljana; the 90 participants were students of that university who declared themselves to be monolingual native speakers of Slovene but who either studied English or translation or else had a high level of English. All had either studied English formally or had had English-medium education for a total of at least eight years (overall, they had learnt English formally for a minimum of 5 years (mean = 10 years), and self-rated their English skills in reading, writing, understanding and conversing as 7.86 (mean) on a scale of 1-10 where 10 is perfect and 1 not at all (see Appendix B for language questionnaire). Their average age was 21.1 and 16 of the 90 were male.

#### *Materials*

The 63 materials were identical to those used in experiment 2, except that the participants additionally completed a language knowledge questionnaire. There were eight practice items used in the practice session, followed by a further eight practice items which were placed at the beginning of the experiment and were excluded from the analysis.

Response	Singular head noun			<i>two</i> head noun			<i>many</i> head noun		
Local	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>
singular	395	294	284	55	21	32	38	16	13
plural	12	65	62	312	268	304	329	275	278

Table 3.3: Experiment 4 (L2 speakers of English) - raw responses of all agreement produced

### *Scoring, Design and Data Analyses*

As in the previous experiments. Additionally, the results of Experiments 3 and 4 were analysed together with a three (head noun number) by three (local noun number) ANOVA for correct and erroneous responses, with native language (Slovene or English) as a between-groups factor.

#### 3.3.5 *Results*

There were 5670 responses. 22 were excluded due to technical error. Two participants were excluded due to failure to complete the task. Of the remaining 5585 responses, 3053 were correctly repeated preambles followed by a completion which was unambiguously marked for number agreement. These last were analysed as in the previous experiments. Where no response with number agreement marking was produced in a particular condition (for a participant or item), the missing proportion was replaced with the mean of that response in that condition. No cells were replaced in the subject file, ten in the items file.

We can again look first at the most commonly studied set, singular and plural. When the plural was conceptually more plural, using the quantifier *many*, there were more plural agreement errors after a singular head followed by a plural (17.9%) than a singular head followed by a singular local noun (2.9%), thus I found a plural attraction effect after *many* of 15.0%. There were also more singular agreement errors after a plural head followed by a singular local noun (10.4%) than a plural local noun (4.5%), thus the singular attraction effect after a plural head noun with the quantifier *many* was significant though weaker at 5.9% (see 3.3). A 2\*2 (head\*match) ANOVA with singular and plural errors as the dependent variable revealed an effect of head noun, marginal by items ( $F_1(1, 87) = 6.36, p < .02$ ;  $F_2(1, 62) = 3.39, p = .070$ ); an effect of match ( $F_1(1, 87) = 36.08, p < .001$ ;  $F_2(1, 62) = 54.06, p < .001$ ); and an interaction ( $F_1(1, 87) = 9.73, p = .002$ ;  $F_2(1, 62) = 7.40, p < .01$ ); with simple match vs. mismatch effects with singular head ( $F_1(1, 87) = 34.13, p < .001$ ;  $F_2(1, 62) = 38.12, p < .001$ ); and simple match

vs. mismatch effects with plural head ( $F_1(1, 87) = 6.50, p < .002$ ;  $F_2(1, 62) = 13.29, p = .001$ ).

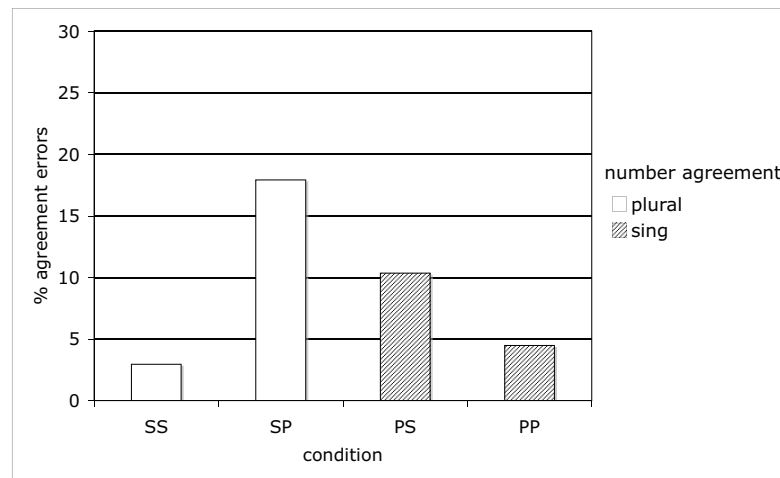


Figure 3.3: Experiment 4 - plural agreement errors for singular heads and singular agreement errors for plural *many* heads - L2 speakers

agreement errors for the singular head (singular, *many* plural local noun) conditions and the plural *many* head (singular, *many* plural local noun)

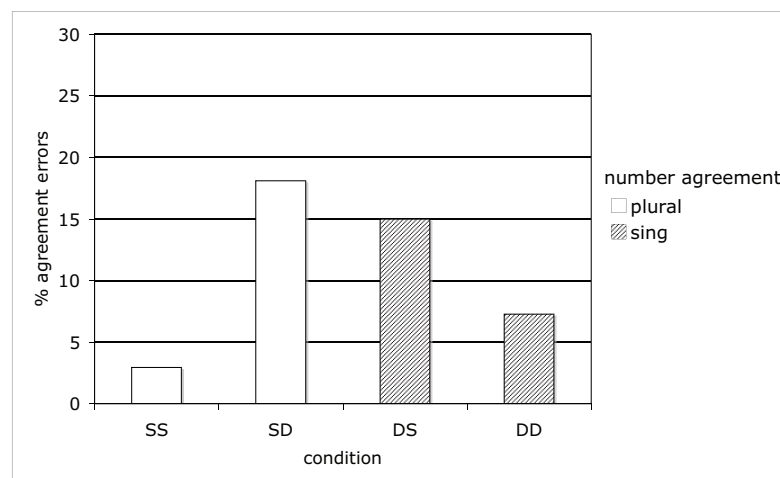


Figure 3.4: Experiment 4 - plural agreement errors for singular heads and singular agreement errors for plural *two* heads - L2 speakers

agreement errors for the singular head (singular, *two* plural local noun) conditions and the plural *two* head (singular, *two* plural local noun)

When the plural was a pseudo-dual, using the quantifier *two*, there were more plural agreement errors after a singular head followed by a pseudo-dual plural (18.1%) than a singular head followed by a singular local noun (2.9%), thus I found a plural attraction effect after *two* of 14.2%. There were also more singular

Response	Singular head noun			<i>two</i> head noun			<i>many</i> head noun		
	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>	Sing	<i>two</i>	<i>many</i>
singular	97.1	81.9	82.1	15.0	7.3	9.5	10.4	5.5	4.5
plural	2.9	18.1	17.9	85.0	92.7	90.5	89.6	94.5	95.5

Table 3.4: Experiment 4 (L2 speakers of English) - percentages of all agreement produced

agreement errors after a pseudo-dual plural head followed by a singular local noun (15.0%) than a pseudo-dual plural local noun (7.3%), so there was a singular attraction effect of 7.7%, thus there was a stronger pseudo-dual plural attraction effect than a singular attraction effect (see Figure 3.4). A 2\*2 (head\*match) ANOVA with singular and plural errors as the dependent variable revealed no effect of head (all  $F_s < 1$ ); an effect of match ( $F_1(1, 87) = 32.86, p < .001$ ;  $F_2(1, 62) = 44.73, p < .001$ ); but no interaction ( $F_1(1, 87) = 1.20, p > .1$ );  $F_2(1, 62) = 2.26, p > .1$ ); there were, however, simple match versus mismatch effects with singular head ( $F_1(1, 87) = 36.77, p < .001$ ;  $F_2(1, 62) = 32.80, p < .001$ ); simple match vs. mismatch effects with dual head ( $F_1(1, 87) = 9.42, p < .005$ ;  $F_2(1, 62) = 12.79, p = .001$ ) showing that there were singular and plural attraction errors, but unlike with the quantifier *many*, with the quantifier *two*, there were an increased number of singular errors, thus singular and plural attraction errors did not differ from each other. The percentages of agreement responses produced in Experiment 4 are shown in Table 3.4.

The two non-singular number values appeared to differ little in their relation to the singular. There were not significantly more plural attraction errors<sup>4</sup> after the pseudo-dual (*two*) than after the conceptually-larger plural (*many*) local noun when the head was singular (all  $F_s < 2$ ). Whilst the number of the local noun made no difference to the number of random singular errors produced after a dual head noun (all  $F_s < 2$ ) or a *many* head noun (all  $F_s < 2$ ), there slightly were more singular random errors after a pseudo-dual than a *many* head noun when the local noun involved *many* ( $F_1(1, 87) = 5.23, p < .03$ ;  $F_2(1, 57) = 9.99, p = .002$ ) though not when the local noun involved *two* (all  $F_s < 2$ ), and there were more singular agreement errors after the pseudo-dual (*two*) than after the conceptually-larger plural (*many*) head, though this was marginal by items ( $F_1(1, 87) = 9.85, p = .02$ ;  $F_2(1, 57) = 3.56, p = .064$ ), but an ANOVA reveals that despite a significant effect of head ( $F_1(1, 87) = 9.95, p = .02$ ;  $F_2(1, 57) = 4.09, p$

<sup>4</sup>As above, since the control condition is the same for both *two* and *many*, I compare the two plural conditions directly with each other.

< .05) and match ( $F_1(1, 87) = 12.05, p = .001$ ;  $F_2(1, 57) = 20.45, p < .001$ ), there was no interaction (all  $F$ s < 2)

### 3.3.6 Discussion of Experiment 4

In common with previous findings, the attraction effect is stronger after a singular than a plural head noun, despite number marking on singular determiner - plural attraction effects with *two* and *many* local nouns after singular heads are stronger than singular attraction effects with a singular local noun after a plural head. This is loosely consistent with a markedness explanation in that the singular is less marked than the plural (or not marked). It is not clear what the mechanism by which singular attraction effects are generated could be, however, if the singular is unmarked, since this explanation is dependent on there being not fewer singular attraction effects but no difference between singular random errors after a plural head modified by a plural local noun and singular attraction effects after a plural head modified by a singular local noun.

As predicted, there was significantly more erroneously-produced singular agreement after a *two* than a *many* head, suggesting that semantics affects agreement processing, at least on the head noun. This is consistent with MMM, which allows semantics to influence agreement processing at the marking stage, when the number value is assigned to the controller. The direction of the result is consistent with an explanation based on the numerosity of the quantifier *two*, which is closer to a singular, in comparison to the quantifier *many*, which is more plural.

As predicted, there was little difference between the rate of (random) singular agreement errors after a *two* or *many* local noun conditions after *two* head or after a *many* head.

There was no difference between *two* and *many* local noun conditions with a singular head noun. This result is also consistent with MMM, since after marking has taken place, semantic information is not available and therefore the difference between *two* and *many* in the local noun condition would be predicted to be nullified before morphing, when the number value is transferred to the target. This is also predicted by the Markedness Differential Hypothesis (Eckman, 1977), which predicts that unmarked L1 features in L1 are more likely to transfer to L2, whereas marked features in L1 (such as dual number) will not transfer.

The results are also broadly compatible with a constraint-satisfaction account, if we assume that the constraints may differ between speakers with differing resources available during production. Slovenian speakers of English, having limited processing resources available, may be unable to distinguish between the semantic niceties of various quantifiers.

### 3.3.7 Results of Experiments 3 and 4 combined

A series of ANOVAs were carried out, with both two (head) by two (local noun) design, and simple effects (comparing the match and mismatch conditions only). The agreement produced in each number was used as the dependent variable. One analysis of variance was carried out with participants as random factor and language (L1 or native English speaker group and L2 or native Slovene speaker group) used as a between-groups factor. All effects that are reported as significant achieved significance at the .05 level or beyond. First language did not interact with any other factor, except for the following cases.<sup>5</sup>

Both language groups produced singular and plural attraction errors when the plural was quantified by *many*, but there were slightly more singular than plural attraction errors for the L2 speakers, whereas the L1 speakers produced a significantly stronger plural than singular attraction effect. A 2\*2 ANOVA with first language as a between-groups factor showed a significant interaction between head and language ( $F_1(1, 185) = 8.65, p < .005$ ), between match and language ( $F_1(1, 185) = 7.40, p < .01$ ), head and match ( $F_1(1, 185) = 11.63, p < .001$ ), and a marginal interaction between head, match and language ( $F_1(1, 185) = 2.91, p = .090$ ).

Both language groups produced singular and plural attraction errors when the plural was quantified by *two* but here the pattern was reversed: whilst the L1 speakers showed a clear asymmetry with a stronger plural than singular attraction effect, the L2 speakers showed very similar numbers of plural errors caused by a pseudo-dual and singular errors. The groups did not differ significantly.

Plural attraction error rates after a *two* local noun were higher (11.4%) than after a *many* local noun (4.9%) when the head was singular when the participants' native language was English. Slovenian L2 speakers of English conversely produced slightly fewer plural errors after a *two* (11.9%) than *many* (13.7%). The

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<sup>5</sup>*F* values which failed to reach 1 are not reported.

interaction between local noun and first language of participants is significant both when including the baseline match condition ( $F_1(2, 184) = 5.33, p < .01$ ), and when only comparing the two mismatch conditions ( $F_1(1, 185) = 8.21, p < .005$ ).

### 3.3.8 Discussion of Experiments 3 and 4

In common with previous findings, in Experiments 3 and 4, the attraction effect is stronger after a singular than a plural head noun, despite number marking on the singular determiner - plural attraction effects with *two* and *many* local nouns after singular heads are weaker than singular attraction effects with a singular local noun after a plural head. I replicated the pattern of asymmetry which tends to be found in English, but there were significant singular attraction effects in both experiments, thus the effects cannot be explained in terms of the singular being unmarked: if the singular is unmarked, it does not have a feature to erroneously transmit to any would-be plural forms, thus there should be no difference between the singular attraction errors and singular random errors.

As predicted, there was significantly more erroneously-produced singular agreement after a *two* than a *many* head, suggesting semantics affects agreement processing, at least the semantics of the head noun and there was little difference between the rate of (random) singular agreement errors after a *two* or *many* local noun conditions after *two* head or after a *many* head. Taken together, these results also provide support for the MMM theory, specifically the claim that the same semantic information is available to aid normal agreement control (marking) but not after the subject has been marked for number and merely needs to transfer the number mark to the target (morphing).

For native English speakers, plural error rates after a *two* local noun were higher than after a *many* local noun when the head was singular. Slovenian participants were less sensitive to the distinction between *two* and *many*, and in fact produced slightly fewer plural errors after *two* than *many*. However, this is perhaps also related to the influence of participants' first language: we may imagine that the pseudo-dual is less marked or more predictable for speakers of a language with a dual (i.e. Slovenians) than for speakers of a language without one (the native English speakers). In this way, it would be logical to expect a semantic difference between *two* and *many* amongst the L1 speakers with more plural errors after

Condition	% agreement errors		
	Slovene	English L1	English L2
ss	(0.6) / (0.5)	(1.7)	(2.9)
sd	11.5 / (1.4)	15.1	18.1
sp	(2.3) / 6.5	8.3	17.9
ds	21.7 / (3.0)	16.9	15.0
dd	(11.3) / (5.4)	(10.8)	(7.3)
dp	(9.4) / 15.6	(10.3)	(9.5)
ps	11.5 / (4.8)	9.8	10.4
pd	(3.1) / 26.6	(6.0)	(5.5)
pp	(2.0) / (6.8)	(7.8)	(4.5)

Table 3.5: Comparison of Slovene, English L1 and L2 results.

Random errors are shown in parentheses.

a *two* local, which is what I found. Similarly, we would thus expect a semantic difference between *two* and *many* amongst the L1 speakers in the head noun position, with more errors after *two* than after *many*, which is what I found. Furthermore, this is actually predicted by the Markedness Differential Hypothesis (Eckman, 1977), which predicts that unmarked features in L1 are more likely to transfer to L2, whereas marked features in L1 (such as dual number) will not transfer.

The results are also broadly compatible with a constraint-satisfaction account, if we assume that the constraints may differ between speakers with differing resources available during production.

### 3.4 Discussion of Experiments 2-4

Table 3.5 shows the results from the last three experiments for comparison<sup>6</sup>.

The first language data show remarkable similarities despite the grammatical differences between English and Slovene. Both produce singular attraction errors as well as non-singular attraction errors. Both show a heightened attraction effect after a (pseudo-) dual compared to a (*many*) plural - both when the (pseudo-) dual is in head position (counting singular attraction errors) and in local noun position (counting dual attraction errors in Slovene or plural attraction errors in

<sup>6</sup>The abbreviations used refer to singular, dual and plural in the Slovene, whereas in the English, they refer to singular, pseudo-dual or *two*, and *many* plural. In the Slovene, when there are clearly two different error options, the first number shown is the lower of the two, e.g., dual errors then plural errors in the singular head conditions.

English). There are also more singular agreement errors in the (pseudo-) dual match condition than in the plural match condition, though there is still a plural attraction effect after a (pseudo-) dual head noun. The pattern of data differs only in the *many-two* condition, where the very high number of dual attraction errors is not mirrored by an analogously high number of singular errors in the English - perhaps unsurprisingly, since the errors that are found here are random errors not attraction errors. The pattern of errors is also roughly similar in the English L2 case, with the additional exception that instead of at least twice as many non-singular errors in the singular-*two* condition as in the singular-*many* condition, we see slightly more errors in the latter.

In Chapter 2, I suggested that the conflation of susceptibility to attraction and strength of attraction might be misleading. If the markedness hierarchy had held we would have expected to find the susceptibility pattern singular > plural > dual and its inverse, the strength of attraction pattern singular < plural < dual. The dual is both most attractive (i.e. causes most errors) and is most susceptible to errors.

Strength of attraction / agreement and susceptibility to attraction / agreement are hard to calculate in English, since the plural errors caused by *two* are not distinguishable from the random plural errors, likewise the plural errors caused by *many* are not distinguishable from the plural random errors. However, in English L1, the *two* plural is also associated with the most errors as an attractor and in terms of susceptibility.

For L2 Slovene speakers of English, the pattern is for susceptibility, pseudo-dual < singular > plural. For error-causing, the plural is again least likely to cause attraction errors; the pattern is plural < singular < pseudo-dual. the *many* plural causes more errors on the singular than for L1 speakers, thus the plural local noun conditions do not differ. Unlike in the Slovene L1 experiment, where the dual was problematic, for the Slovene L2 speakers of English, the pseudo-dual was comparatively less problematic, suggesting that processing difficulties may be a more plausible explanation for the differences between the results of Experiments 3 and 4, rather than familiarity with the dual due to their native language.

These results may differ, but one pattern is clearly evident: once random errors are partialled out, the plural is not likely to cause errors despite its marked feature compared to the singular. Another noticeable problem for a pure markedness-based explanation of agreement error patterns is that random errors are usually

caught up with what we like to think of as attraction errors, and this changes the pattern markedly. This is inevitably the case with the English results presented here, despite the attempt to emulate a three-way number system, because responses with agreement are necessarily either singular or plural, thus although it is relatively trivial to calculate the attractiveness of the singular, it is extremely difficult to do this separately for the two plural forms of local noun used, *two* and *many*.

I found little difference between native and non-native speakers in their agreement error patterns. Contrary to the hypothesis, the Slovene speakers did not replicate the higher levels of agreement errors associated with the dual in the English pseudo-dual. On the contrary, the only place where the pattern of errors between L1 and L2 speakers differed was in the higher rates of errors for L1 speakers when a *two* local noun followed a singular head (relative to the error rates after a *many* local noun). This suggests that if anything, it was the English speakers who had difficulty with the unfamiliar semantic division into *two* versus *many*, whereas for Slovene speakers *two* was no more difficult than *many*.

### 3.5 General discussion

It is clear from the results of the two English experiments which compared not syntactically-encoded differences but differences in semantics alone, that a purely syntactic agreement processing mechanism cannot function even at the level of relatively simple quantifiers. Whilst the results are mixed regarding the role of the semantics of the local noun, it seems simpler to explain the lack of effects in the native speakers as being due to processing constraints or L1 (lack of) transfer than to explain the effects found for the native English speakers. It would be interesting to see a marking and morphing account of these results, but these results are problematic for a system which proposes encapsulation of the semantics of the local noun whilst allowing the semantics of the head noun to influence the agreement processing late enough to cause attraction errors (i.e. MMM).

Although I replicated the well-documented finding of an asymmetry between singular and plural from the literature, I found a robust singular attraction effect, suggesting that the singular cannot be entirely unmarked, but must be merely less marked. The markedness explanation used by Eberhard cannot simply be applied cross-linguistically, as it is too simplistic once we are able to examine random errors separately from attraction errors and to see that there is a difference

between susceptibility to agreement errors and attractiveness. This difference is likely to be caused by the notion of a default. This concept is often wrapped up in definitions of markedness, yet it is also problematic, since there may be more than one default (as for example in German plurals formation). I have shown that the notion of default can be separated from the notion of comparing attraction errors. As we saw in Chapter 2, although the singular would be the first choice for a default number value in Slovene, there were more dual agreement errors produced than there were singular errors (especially due to its occurrence in the plural head conditions). Similarly, in both English experiments, there was more erroneous plural agreement produced than singular agreement, although the singular is explicitly referred to as the default in English agreement (Eberhard, 1997). Thus it is clear that reversion to the default is not the only process which causes random error generation.

I do not want to reject markedness wholesale, however. It clearly provides a useful framework to think about agreement processing. The dual is clearly associated with errors. Although it is not only error-causing but also extremely sensitive to errors, this does not mean that the concept of markedness is not useful, only that it has been over-interpreted. It is not possible to claim that the singular has no marked features and that this lack of marked features means that it does not cause attraction errors whilst it is susceptible to them: it is merely the case that the number of singular errors which occur for other reasons (such as reversion to the default) swamp the attraction errors. Arguably any attraction effect seen in English is due to the use of number-marked determiners in the reported experiments, but note that the Slovene experiments employed no such device, that the Slovene masculine singular is morphophonologically unmarked in the same way that the English singular is, and yet we still saw singular attraction errors. In English, the pseudo-dual is less marked or more predictable for speakers of a language with a dual (i.e. Slovenians) than for speakers of a language without one (the native English speakers), suggesting that the markedness of the dual in Slovene is not purely syntactic. Thus we saw a pronounced semantic difference between *two* and *many* amongst the L1 speakers with more errors everywhere, compared to the Slovene speakers who have not transferred marked features in L1 to their English L2.

Comparison with other languages - perhaps with more complex morphology or certainly with different morphology to English (and the few other usual suspects) - can lead to a greater understanding of language processing even in En-

glish. To that end, in the next chapter, we shall look at something of which there are few remnants in English, gender.

## CHAPTER 4

### Gender

#### 4.1 Introduction

Although there is a wealth of research in the area of number agreement processing, investigation into gender agreement processing has been much more limited, and has generally focussed on secondary concerns such as morphophonological and / or semantic effects. Since Slovene has grammatical gender, it is possible to investigate this aspect of agreement processing without recourse to discourse, which is arguably what drives most ordinary number agreement (with the exception of collectives, mass nouns, bipartites and other special number forms). Slovene has three genders. What research there has been into gender agreement processing has been limited to a bipartite gender system (e.g., Franck et al., 1999; Hupet, Fayol & Scheltraete, 1998; Kempe & Vigliocco, 2001; Meyer & Bock, 1999; Vigliocco et al., 1999; Vigliocco & Franck, 1999, 2001; Vigliocco & Zilli, 1999; Vigliocco et al., 2002a) of to only two genders even in languages with three genders (Hemforth and Konieczny, 2003; Badecker and Kuminiak, 2007). Slovene, having tripartite gender and number systems, allows us to compare complex agreement patterns in gender and in number for the first time within the same language.

Slovene has grammatical gender, not just semantic gender like in English e.g. (from Bajec et al., 1956),

(215) stranka je bil-a v trgovini  
customer.F AUX.SG be.PPL-F in shop  
'The customer was in the shop'

- (216) Ančka je bil-a pridn-o dekle  
 Ančka AUX.SG be.PPL-F good-N girl.N  
 ‘Ančka was a good girl’
- (217) siročče je bil-o v polju  
 orphan.N AUX.SG be.PPL-N in field.N.LOC  
 ‘The orphan was in a field’
- (218) zdravnik je bil sošed(-ov-a bivša žena)  
 doctor.M AUX.SG be.PPL-M neighbour.M(-POSS-F ex.F wife.F)  
 ‘The doctor was the neighbour(‘s wife)’
- (219) predalnik je bil v trgovini  
 chest.of.drawers.M AUX.SG be.PPL in shop  
 ‘The chest of drawers was in the shop’

Thus grammatically feminine nouns may have masculine (e.g., *stranka* in Example 215) or no biological gender (e.g., *trgovina*), grammatically neuter nouns may have feminine or masculine biological gender (e.g., *siročče* in Example 217) or no biological gender (e.g., *polje*), and grammatically masculine nouns may have masculine or feminine (e.g., *zdravnik* in Example 218) or no biological gender (e.g., *predalnik* in Example 219).

Levelt et al. (1999) claim that gender is lexicalised and stored separately for each word and has to be retrieved. Corbett (1991) suggests that it is instead computed through assessing a noun’s semantics and / or form (the input of each of these elements varying cross-linguistically). Zubin and Köpcke (1981, 1986) claimed that gender was both semantically and phonologically assigned. This would be impossible on the Levelt et al. account since phonology is not accessible at the point when gender would be assigned; in production, phonology is computed after syntax (including agreement). Schwichtenberg and Schiller (2004) tested whether gender assignment was influenced by semantics at all and found that it was. Namely, pseudo-words associated with certain categories were more likely to be assigned to certain genders (fruit, musical instruments and insects being assigned more often to feminine and stone, spices and predators being assigned more often to masculine).

Chapter 4 seeks to investigate whether gender agreement functions in the same way as number agreement, and, more precisely, whether the lexicalised nature of gender (Levelt et al., 1999) means that its production differs to that of number agreement (Zubin and Köpcke, 1981, 1986); the concept of markedness has

been argued to elucidate the workings of number agreement, but is it relevant in the area of gender agreement (Vigliocco and Franck, 1999, 2001; Vigliocco and Zilli, 1999; Hartsuiker et al., 2003; Meyer and Bock, 1999), and, if so, which gender would be the unmarked one (Corbett, 1991; Moravcsik, 1978; Schane, 1970; Blevins, 2000; Jakobson, 1960). If we assume that gender has been assigned to a particular noun, what is the next step? How is gender agreement produced? Does markedness play a role? Finally, by comparing different types of noun (human versus nonhuman, collective versus non-collective), we can see whether semantic categories force agreement to be processed differently.

#### 4.1.1 *Theoretical linguistic examination of gender markedness in agreement*

If we want to know whether markedness plays a role in gender agreement, then we need to know what it would mean for genders to be marked, and which gender(s) would be predicted to be the marked one(s).

When Jakobson extended the use of Trubetskoy's term markedness to semantic oppositions such as the difference between general terms (e.g., *dog*) which are unmarked and specific terms (e.g., *bitch*) which are marked (Haspelmath, 2006), this clearly involved the idea of gender. Jakobson (1990) originally gave the example of a donkey *osël* compared to a female donkey *oslíca*; the marked member is semantically more specific than the unmarked member as it can only refer to a female donkey, whereas the unmarked member of the pair can refer to any donkey, regardless of sex.

This concept of markedness concerns only hyponyms, and even in languages such as Slovene where most words denoting humans and animals have different gender equivalents, the majority of the words in the language do not have the hierarchical relation of these examples, yet still have a gender. Can one gender be said to be more marked than another gender? It has been proposed, notably by Schane (1970), that genders differ in markedness, but the idea is less well established than with number. Schane (1970) argued that in French, phonological markedness (i.e. an extra phoneme) in the underlying representation (as evinced in liaison) corresponded to morphological markedness (e.g., gender or number), thus Example 220 would be less marked than Example 221 (plural) or Example 222 (feminine), and the most marked would be Example 223 (both plural and feminine).

- (220) petit  
/pətit/  
'small'
- (221) petits  
/pətitz/  
'small'
- (222) petite  
/pətitə/  
'small'
- (223) petites  
/pətitəz/  
'small'

However, most theoretical linguists claim that genders are marked with regard to each other, specifically that the neuter is unmarked (e.g., Blevins, 2000; Jakobson, 1960). Corbett (1991) claims that markedness cannot work for gender systems which involve more than two genders, thus he dismisses its explanatory value in agreement processing. This is because “the clustering of properties no longer obtains” (Corbett, 1991, p.290). The first problem is that Slovene has portmanteau gender and number, thus although masculine singular is the simplest morphophonological form, it is not easy to state what a gender marker is, it being conflated with the number markers in every case except masculine singular. Although, as stated in the last chapter, the notion of default is perhaps best addressed separately, it is nonetheless often seen as a criterion of markedness. In this sense, Slovene is problematic because, as will be explained below, there are two defaults (according to Schane’s criteria), masculine and neuter depending on certain factors. Corbett appeals to “semantic justification” as the “main factor” in gender agreement. This means that, for instance, if a noun denotes a female, it will tend to be feminine, and if it denotes a male, it will tend to be masculine. If semantics cannot help, then form is appealed to (with the most generic form used as resolved form in the case of conjuncts (as specific generic in Cushitic languages like Bayso and Qafar, or one of the forms designated to the task in other languages). Schane claims that the unmarked form is the resolved form (i.e. the form used with conjuncts of differing values or in mixed groups), which might be masculine (e.g., Slovene) or neuter (e.g., Icelandic), or masculine or neuter depending on animacy (e.g., Latin - Moravcsik, 1978). Corbett denies that the unmarked can be the resolved form, appealing to number (where plural is accepted as marked but is the resolved form in many languages) and person

(first person is the “favoured” or resolved form, e.g., Example 224, yet it is also marked). Of course, it is not logically impossible that markedness (or rather unmarkedness) could be the decisive factor in gender but not in person or number, but it introduces differences between the systems.

(224) My brother/You and I love our/\*his/\*their/\*your mother

So is there any independent evidence for one gender being unmarked? If the unmarked is the default, then there is mixed evidence in Slovene. The neuter is often the default in a simple system involving masculine, feminine and neuter, agreeing with ungendered ‘what’ or after quantified phrases involving a number above four, e.g.,

(225) kaj je bil-o  
 what AUX.SG be.PPL-N  
 ‘What happened?’

(226) pet krav je bil-o  
 five cow.GEN.F AUX.SG be.PPL-N  
 ‘There were five cows’

but the masculine may also be used when the referent is human but unknown such as with ‘who’, e.g.,

(227) kdo je pršel  
 who AUX.SG come.M  
 ‘Who has come?’

Corbett (1991) states that where available, non-human genders are used for neutral agreement. Insofar as neuter is used as the default in Slovene, it is so, according to Corbett, because it is almost never semantically assigned to animates<sup>1</sup>.

Final evidence comes from morphophonology: the masculine agreement is morphophonologically unmarked, compared to the feminine (–*a* must be added) or

<sup>1</sup>There are a few exceptions when it can be used for animates, especially for the young, e.g., *tele* ‘calf’, and pejoratively, e.g., *ženšče* ‘little old lady’; but note that it is not necessary to use a neuter word for the young (e.g., there is also a masculine word for ‘calf’, *teliček*), or pejoratively (not only is the usual word for woman, *ženska*, feminine, but there are other feminine pejorative terms, e.g., *baba* ‘hag’).

neuter (–o must be added). Overall, it is difficult to say whether the neuter or the masculine should be the unmarked gender in Slovene (if we accept that one gender should be), but it seems likely that the feminine is marked.

#### 4.1.2 *Psycholinguistic examination of gender in agreement*

Attraction effects, or at least effects of congruency, have been found in various languages (Dutch and German: Hartsuiker, Schriefers, Bock, & Kikstra, 1999; Romance: Vigliocco & Franck, 1999, 2001; Vigliocco, Franck, et al., 1999; Russian: Kempe & Vigliocco, 2001). Costa et al. (2003) suggest that (in this case two) genders are functionally autonomous in the languages of bilinguals. Psycholinguistic studies of grammatical gender tend to have concentrated thus far on morphophonological effects (e.g., Franck et al., 1999; Meyer & Bock, 1998; Vigliocco et al., 1999; Vigliocco & Zilli, 1999) and conceptual effects (Vigliocco & Franck, 1999, 2001; Hupet, Fayol & Scheltraete, 1998) or both (Kempe & Vigliocco, 2001; Vigliocco et al., 2002a). This study will look at effects which are not morphophonological or conceptual, but relate to the purely arbitrary category of grammatical gender.

The rates of gender and number agreement errors within a language usually differ considerably. They are considerably greater for number than for gender, suggesting two different agreement mechanisms (Vigliocco et al., 1996a). Antón-Méndez et al. (2002) attempted to compare number agreement (which is usually tested by examining verbal agreement) and gender agreement (which is usually tested by examining adjective agreement) to assess whether there are indeed two different mechanisms. Their participants completed sentences containing a head noun (always singular, masculine or feminine) and a local noun (which varied as to whether it was masculine or feminine and as to whether it was singular or plural). They found the rate of errors combining erroneous gender and number agreement to be no greater than chance according to the number of separate gender errors and number errors, suggesting them to be independent processes (according to additive factors logic).

Grammatical gender clearly differs from number, tending to be an inherent noun property rather than varying with discourse context whereas number tends to vary with discourse context (although there are exceptions, e.g., gender pairs

of names for professions like *actor-actress* and invariant number-marked pluralia tantum, mass nouns and collectives such as *suds, soap, troupe*). Nonetheless, similar effects to those found in number agreement have also been observed with gender agreement (e.g., Meyer and Bock, 1999; Vigliocco and Franck, 1999). Meyer and Bock (1999) found morphophonological gender marking effects on Dutch pronouns when the pronoun and antecedent were within the same sentence. They presented participants with preambles like Example 228.

- (228) Kijk, daar ligt een aardappel bij een badpak (die / dat  
 look there lie.SG a potato.C by a swimsuit.N COMP.C / COMP.N  
 gaar is)  
 cooked is  
 'Look, there's a potato lying next to a swimsuit (that's cooked)'
- (229) Die / Dat gaar is  
 it.C / it.N cooked is  
 'It's cooked'

The participants' task was to complete the sentence using a relative clause (as shown in parentheses) or a full sentence (Example 229). Meyer and Bock (1999) found that participants were susceptible to the same attraction effects when the local noun differed in gender from the head noun compared to when the two matched for gender.

As noted in Chapter 1, there are several studies showing subject-verb attraction errors in gender. Vigliocco and Franck (1999) and Vigliocco and Zilli (1999) found little difference between masculine and feminine attraction effects in Italian (compared to the asymmetry often observed in number between singular and plural, e.g., Bock & Miller, 1991), i.e. there were a comparable number of agreement errors after a masculine head (Example 230) as after a feminine head (Example 231).

- (230) lo sposo in chiesa  
 the.M groom.M in church.F  
 'The groom in the church'
- (231) la bidella nell' atrio  
 the.F janitor.F in hall.M  
 'The janitor in the hall'

In French, more errors were found after a feminine head noun compared to a masculine head noun, and conversely, more errors were caused by a masculine local noun, although the unmarked form is usually the most susceptible to errors and the least error-causing according to psycholinguistic research into number markedness (Eberhard, 1997) (and the masculine is certainly regarded as the unmarked gender in French, as discussed above, being the choice when gender is resolved in coordination as well as with generic reference, and because it is phonologically simpler).

Thus previous research has suggested that the unmarked gender is not the most susceptible to attraction errors: errors are more common for feminine compared to masculine head nouns (Vigliocco and Franck, 1999, 2001; Schriefers and van Kampen, 1993, in French and German); errors have been attributed to the use of “unmarked adjectival form” in French (Vigliocco and Franck, 2001), or to the use of the default form (Vigliocco and Franck, 2001). This contrasts starkly with number agreement results, where it has generally been found, at least in languages with just two number values, that it is the unmarked number (i.e. the singular) that is susceptible to attraction errors (Bock and Cutting, 1992; Bock et al., 1999; Hemforth and Konieczny, 2003; Thornton and MacDonald, 2003; Vigliocco and Nicol, 1998; Vigliocco et al., 1995, 1996a). Hartsuiker et al. (2003) also found that feminine head nouns were more susceptible to number agreement errors than masculine or neuter head nouns, but this is likely to be due to the fact that feminine singular nouns take the same determiner as plural nouns in German rather than any inherent susceptibility; and they did not investigate gender agreement per se. In Dutch, Hartsuiker et al. (2003) found that common head nouns were more susceptible to errors, but this is assumed to be due to the ambiguity of the common gender singular determiner and the plural determiner - they have an identical form. Finally, Antón-Méndez et al. (2002) also found that feminine head nouns elicited fewer correct responses in Spanish. However, there are no definitive results regarding markedness in gender agreement. Vigliocco and Franck (1999), Vigliocco and Zilli (1999) and Hartsuiker et al. (2003) did not find a “default gender” in terms of error proportions.

Meyer & Bock (1999) test a “tag hypothesis” for gender agreement production, whereby although conceptual and lexical information is available, tag information dominates (speakers rely on an antecedent’s explicit markers of grammatical gender when selecting the gender of an anaphoric pronoun). They used a sentence completion task (and a similar inter-sentential task) to test whether

pronouns production was affected by the mismatching gender of an intervening local noun. They found that it was, ruling out a purely conceptual process of agreement and suggesting that if gender is a property carried principally by gender tags (like determiners) rather than by the lexical entries of nouns, gender interference should be most evident in the overt-gender conditions, where gender is marked (i.e. on definite determiners) compared to where it is not specified (i.e. on indefinite articles, where both common and neuter nouns both take *een* 'a'). Overt gender-marking had no significant impact on the error rate as either a main effect or interaction (though there is a trend in the right direction), thus they claim that the tag hypothesis is not supported, that is to say having a determiner marked for gender (definite *de* or *het*) rather than one not marked for gender (indefinite *een*) makes no difference, thus the information which speakers use in order to make decisions about gender must be in the noun itself rather than the determiner. This compares with Eberhard's findings that a singular noun with a generic determiner *the key to the cabinets* is both more susceptible to and less prone to cause attraction than a singular noun with a specifically singular determiner *one key to the cabinets*. She claimed that this is because the singular is unmarked, as previously discussed (see Chapter 2). This then implies that there is no difference in markedness for Dutch gender, since they do not find that one gender's behaviour in agreement can be influenced by the addition of a gender-specific determiner, whereas Eberhard found that the addition of a number-specific determiner did influence one number's behaviour (the singular).

Meyer and Bock (1999) found that common nouns are stronger attractors (or perhaps neuter nouns are weaker). The neuter gender has been shown to be ordinarily error-prone and thus comparatively less sensitive to attraction errors (compared to a baseline of errors with matching local noun) in Dutch (Meyer and Bock, 1999). This is similar to the number findings: plural number is ordinarily error-prone and thus comparatively less sensitive to attraction errors (compared to a baseline of errors with matching local noun) whereas singular head nouns with singular local nouns are extremely stable, thus providing an extremely sensitive baseline condition. However, unlike in (a two-way) number (system), this general susceptibility is not paired with being the stronger attractor. There is thus some debate about whether gender agreement would be susceptible to markedness constraints in a three-gender language like Slovene. Recently, Badecker and Kuminiak (2007) examined gender agreement in a three-gender language (Slovak). They found a masculine attraction effect on neuter gender heads and a feminine attraction effect on masculine gender heads. This

would suggest in markedness terms that the feminine is more marked than the masculine and the masculine more marked than the neuter. However, a further experiment revealed that a feminine local noun does not cause more attraction errors than a masculine local noun, suggesting that, in relation to the neuter, this markedness hierarchy does not hold. This fits in with my previous findings (Chapter 2) about number: markedness works in relation to particular oppositions, rather than overall. Whilst it is simple enough to say that the singular is marked in relation to the plural because it causes more errors on the plural than the plural does on the singular, and likewise the dual is marked in relation to the plural because it causes many more errors on the plural than the plural does on the dual, and that the dual and singular are similarly attractive to each other, this does not give us the whole picture. Since the dual is such a strong attractor on the plural, the dual is a stronger attractor overall than the singular.

## 4.2 Experiment 5: gender attraction errors

Using the sentence completion paradigm, I examined subject-verb agreement in a three-way gender system (Slovene) to see whether one gender is more marked than the other two. In order to test this, I employed a three (head noun gender) by three (local noun gender) fully crossed design. The design was analogous to that used in Experiments 2-4, except that instead of manipulating the three number values, I manipulated the three gender values. A head noun was post-modified with a relative clause including a local noun which either matched (Example 232) or mismatched in gender (Example 233-234).

(232) Avtomobil, ki ga je dohitel bel  
 car.M COMP OBJ.MN AUX.SG overtake.PPL.M white.M  
 tovornjak  
 lorry.M  
 'A car which a white lorry overtook'

(233) Avtomobil, ki ga je dohitelo belo vozilo  
 car.M COMP OBJ.MN AUX.SG overtake.PPL.N white.N vehicle.N  
 'A car which a white vehicle overtook'

(234) Avtomobil ki ga je dohitela bela Lada  
 car.M COMP OBJ.MN AUX.SG overtake.PPL.F white.F Lada.F  
 'A car which a white Lada overtook'

The experimental aims were, more specifically, to replicate the gender match versus mismatch effects for masculine and feminine local nouns, to discover which gender causes most errors, to discover which gender is most susceptible to errors, and to discover which type of nouns cause errors / are susceptible to errors: human, collective, “normal” (i.e. neither human nor collective). To this latter end, the materials were divided into these three categories:

- nouns denoting humans, which may have conflicting conceptual and grammatical gender, like *dekle* ‘girl’ or *revše* ‘wretch’, which are grammatically neuter yet semantically feminine or masculine (and their masculine and feminine equivalents, e.g., *deklica* ‘little girl’, *deček* ‘little boy’)
- collective (and mass) nouns like *skupščina* ‘assembly’ or *ministrstvo* ‘ministry’ (collectives and mass nouns are commonly neuter, seldom masculine)
- normal (not gender- or number-ambiguous) so not denoting either humans and not collectives (or mass nouns), e.g., *konj* ‘horse’ or *sekira* ‘axe’

#### 4.2.1 Predictions

Theoretical linguists (e.g., Blevins, 2000; Jakobson, 1960) claim that the neuter is unmarked. The neuter should thus be susceptible to attraction errors from the other genders and not cause attraction errors. The masculine is claimed to be unmarked with regard to the feminine (Schane, 1970). The masculine thus should be susceptible to attraction errors from the feminine and not cause attraction errors on the feminine. But is neuter more unmarked than masculine? Both are used in different contexts as generic, therefore both can be regarded as unmarked. What about the relationship between feminine and neuter? Either the feminine is most susceptible to errors (a reversion to the default explanation) (Vigliocco and Franck, 2001) or the feminine is least susceptible (because it is the most marked).

According to the findings in this thesis, in particular those in Experiment 2 (Chapter 2), we might expect a different set of results. Namely, the susceptibility and attractiveness should not be inversely correlated.

Assuming markedness holds for gender agreement processing, we may expect human, collective and other nouns to show different agreement patterns. Nouns denoting humans (i.e. fitting with or competing with conceptual gender) are likely to be more susceptible to neuter errors, since the neuter is more marked

Cond	Sentence preamble			Translation
MM	<i>Avtomobil</i>	<i>ki ga je dohitel</i>	<i>bel tovornjak</i>	'A car a white lorry overtook'
MF	<i>Avtomobil</i>	<i>ki ga je dohitela</i>	<i>bela Lada</i>	'A car a white Lada overtook'
MN	<i>Avtomobil</i>	<i>ki ga je dohitelo</i>	<i>belo vozilo</i>	'A car a white vehicle overtook'
FM	<i>Prikolica</i>	<i>ki jo je dohitel</i>	<i>bel tovornjak</i>	'A trailer a white lorry overtook'
FF	<i>Prikolica</i>	<i>ki jo je dohitela</i>	<i>bela Lada</i>	'A trailer a white Lada overtook'
FN	<i>Prikolica</i>	<i>ki jo je dohitelo</i>	<i>belo vozilo</i>	'A trailer a white vehicle overtook'
NM	<i>Kolo</i>	<i>ki ga je dohitel</i>	<i>bel tovornjak</i>	'A bicycle a white lorry overtook'
NF	<i>Kolo</i>	<i>ki ga je dohitela</i>	<i>bela Lada</i>	'A bicycle a white Lada overtook'
NN	<i>Kolo</i>	<i>ki ga je dohitelo</i>	<i>belo vozilo</i>	'A bicycle a white vehicle overtook'

Table 4.1: Experiment 5 experimental items

(being not semantically appropriate). The masculine is the only default for humans, therefore more masculine errors than neuter errors should occur overall in this category. Similarly, masculine gender is rare for collective (and mass) nouns, therefore fewer masculine errors than neuter errors should be found overall in this category.

Alternatively, if markedness does not hold, then we might expect there to be more feminine and masculine (and fewer neuter) responses in the human conditions, since these are the only appropriate genders for (semantic) agreement with human nouns. Conversely, we would expect more neuter and feminine agreement in the collective conditions, since collectives are most commonly neuter or feminine, and are rarely masculine.

#### 4.2.2 Method

##### *Procedure*

To test this hypothesis, speakers performed a sentence completion task. The procedure was as for experiment 1. The presentation times were as follows: fixation point (320ms), verb (550ms), fixation point (360ms), sentence preamble (1400ms), sequence of dots gradually increasing in length until an audio warning sounded at 1360ms.

##### *Materials*

As in Experiments 2-4 set of sentence preambles was produced, comprising a head noun post-modified by a relative clause, as shown in Table 4.1.

A completion verb was also devised for each sentence fragment (e.g., *USTAVITI SE* 'to stop'). There were nine versions of each sentence corresponding to the nine conditions. Additionally, experimental items were classified as to whether they included human nouns, collective or mass nouns, or neither, which I term other or "normal". The materials were developed by native speakers in collaboration with the experimenter. Although some nouns are infrequent, native speakers consulted during the development stage and debriefed during the pilot test phrase asserted that the semantic plausibility of items did not vary according to gender. There were 9 versions of each of the 126 experimental items (45 human, 27 collective, 54 normal) plus 9 practise "warm-up" items and 9 actual warm-up items. The experimental items are listed in Appendix E.

### *Participants*

The experiment was run in the Psychology Department of the University of Ljubljana; data was collected from 54 self-declared native speakers of Slovene, students at Ljubljana University. Nine of the 54 were male.

### *4.2.3 Scoring*

Scoring was done as in previous experiments, except of course that the responses needed to include gender agreement.

### *4.2.4 Design and data analysis*

Each of the 54 participants were asked to complete seven preambles in each of the nine conditions formed by the orthogonal combination of the two factors, gender of head noun (with three levels: masculine, feminine and neuter) and gender of local noun (with three levels: masculine, feminine and neuter). Each of the 126 items occurred in every cell of the design and was presented to six participants in each condition. The major statistical tests were performed using the number of agreement errors as the dependent variable. Pairwise comparisons were made between conditions involving two genders at a time, with the agreement errors being compared after matching and mismatching conditions respectively. The analysis was as in Experiment 1; two analyses of variance were carried out, one with participants and one with experimental items as random factor. All effects that are reported as significant were associated with  $\alpha$  levels less than or equal to .05. Errors are reported as proportions of all responses to facilitate comparison

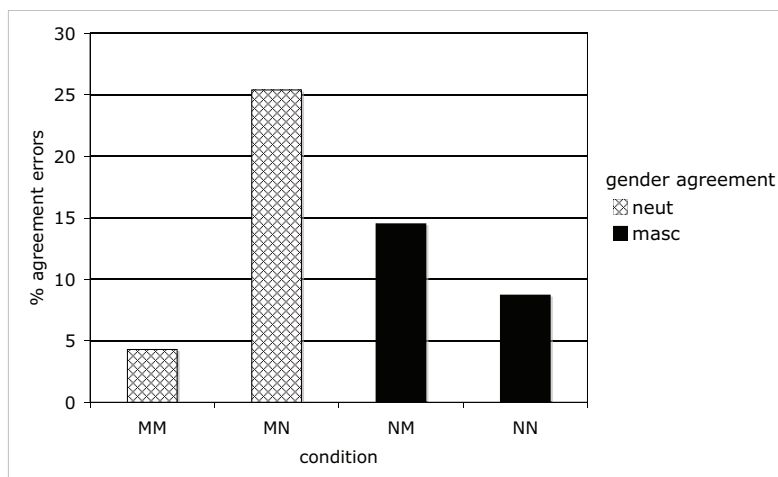


Figure 4.1: Experiment 5 - masculine and neuter agreement errors for masculine and neuter heads

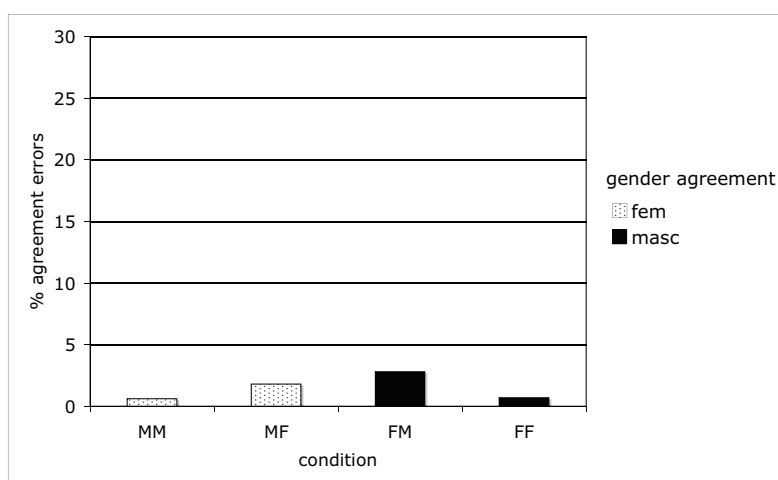


Figure 4.2: Experiment 5 - masculine and feminine agreement errors for masculine and feminine heads

between experiments. The results were analysed firstly all together, and then separately within their categories of human, collective, and normal.

#### 4.2.5 Results

I will first present the results generally, before turning my attention to difference between the three subsets of noun types. Results for the types are therefore collapsed here (see Table 4.3). The responses including agreement are shown for each of the nine conditions, where the head noun is masculine and the second also masculine (MM), the head noun is masculine and the second feminine (MF), the head noun is masculine and the second neuter (MN), and so on.

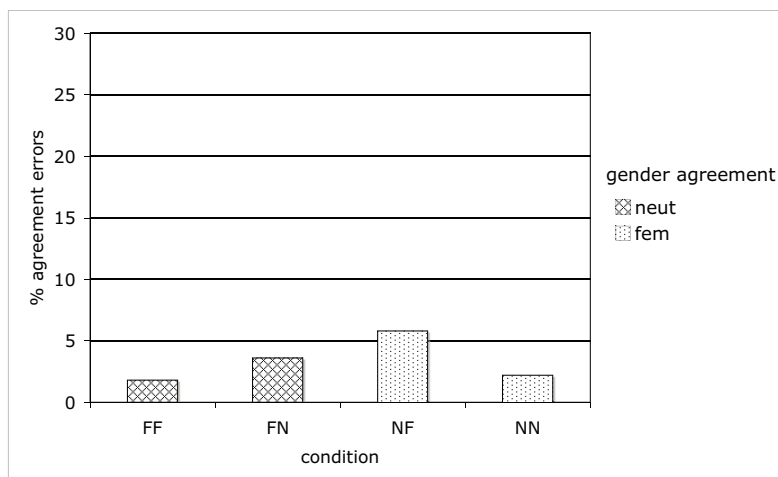


Figure 4.3: Experiment 5 - neuter and feminine agreement errors for neuter and feminine heads

response	Noun gender (head noun, local noun)								
	MM	MF	MN	FM	FF	FN	NM	NF	NN
fem	4	14	9	590	552	560	12	33	12
masc	594	540	420	17	4	9	75	41	47
neut	27	27	146	3	10	21	517	496	481

Table 4.2: Experiment 5 - raw responses of all gender agreement produced

showing agreement errors for masculine heads (feminine, masculine and neuter local nouns), feminine heads (feminine, masculine and neuter local nouns), neuter heads (feminine, masculine and neuter local nouns)

Where no response with gender agreement marking was produced in a particular condition (for a participant or for an item), the missing proportion was replaced with the mean of that response in that condition. No cells were replaced in the participants file but 18 were replaced in the items file.

#### 4.2.6 Details

There were 6804 responses. I excluded one response due to technical problems. I analysed the remaining 6803 as in Experiment 1. Of these, 5261 involved a response with a correctly repeated preamble followed by a verb with gender agreement marking. The conditions of interest were analysed as proportions of all gender agreement marked responses produced in that condition.

## 4.2.7 Overall analyses

*Masculine / Feminine*

The results are shown in Figure 4.2. There were no main effects of head noun (all  $F$ s  $< 2$ ), with no more feminine responses after a masculine head noun (mean of 1.2% errors in the two conditions analysed here, i.e. MM and MF) than masculine errors after a feminine head noun (mean of 1.8% after FF and FM). There was, however, a main effect of match significant by participants only ( $F_1(1, 53) = 8.34$ ,  $p < .01$ ;  $F_2(1, 125) = 5.30$ ,  $p = .23$ ), with more errors when the head and local noun mismatched (mean of 2.3% errors after MF and FM) compared to when they matched (mean of 0.65% after MM and FF). There was no interaction (i.e. there was no significant effect of matching head and local noun) (all  $F$ s  $< 1$ ).

*Masculine / Neuter*

The results are shown in Figure 4.1. There were main effects of head noun, marginal by items ( $F_1(1, 53) = 4.03$ ,  $p < .05$ ;  $F_2(1, 125) = 3.55$ ,  $p = .062$ ), with more masculine responses after a masculine head noun (14.9%) than neuter responses after a neuter one (11.6%), and of match ( $F_1(1, 53) = 78.00$ ,  $p < .001$ ;  $F_2(1, 125) = 63.36$ ,  $p < .001$ ), with more errors when the head and the local noun mismatched (19.9%) compared to when they matched (6.5%). There was an interaction ( $F_1(1, 53) = 24.73$ ,  $p < .001$ ;  $F_2(1, 125) = 31.65$ ,  $p < .001$ ): participants were more likely to produce masculine responses following a masculine head noun when the local noun matched the head noun in gender (21.1% for masculine heads versus 5.8% for neuter heads).

*Feminine / Neuter*

The results are shown in Figure 4.3. There were no main effects of head noun ( $F_1(1, 53) < 1$ ;  $F_2(1, 125) = 2.13$ ,  $p > .1$ ), with no more neuter responses after a feminine head noun (2.7%) than feminine responses after a neuter one (4.0%). There were, however, main effects of match ( $F_1(1, 53) = 9.70$ ,  $p = .003$ ;  $F_2(1, 125) = 6.63$ ,  $p = .011$ ), with more errors when the head and local noun mismatched (4.85%) compared to when they matched (2.0%). There was no interaction (i.e. there was no significant effect of matching head and local noun) (all  $F$ s  $< 1$ ).

	Noun gender (head noun, local noun)								
response	MM	MF	MN	FM	FF	FN	NM	NF	NN
fem	0.6	1.8	1.6	96.7	97.5	94.9	2.0	5.8	2.2
masc	95.0	92.9	73.0	2.8	0.7	1.5	14.5	7.2	8.7
neut	4.3	3.5	25.4	0.5	1.8	3.6	85.6	87.0	89.1

Table 4.3: Experiment 5 - percentages of all gender agreement produced

#### 4.2.8 Human, collective and other nouns

I will now present the results for the three different subsets of noun types. Results for the types are shown in Table 4.4. The responses including agreement are shown for each of the nine conditions, where the head noun is masculine and the second also masculine (MM), the head noun is masculine and the second feminine (MF), the head noun is masculine and the second neuter (MN), and so on, but are further divided into noun phrases including nouns denoting humans, noun phrases including collective nouns<sup>2</sup>, and those including neither of the above. For the analysis, therefore, the participants analysis required recoding of the data into the three groups. As before, where no response with gender agreement marking was produced in a particular condition (for a participant or for an item), the missing proportion was replaced with the mean of that response in that condition. 24 cells were replaced in the new participants file. The items analysis of variance required a between-groups level since each item was only included in one noun type.

#### *Masculine / Feminine*

The results are shown in Figure 4.4. There was no effect of noun type ( $F_1(2, 52) < 1$ ) nor any interaction between head noun, match and noun type ( $F_1(2, 52) < 1$ ;  $F_2(2, 123) < 1$ ). There was also no effect of head noun ( $F_1(1, 53) < 1$ ;  $F_2(1, 123) = 1.07, p > .1$ ) but there was an effect of match ( $F_1(1, 53) = 11.02, p = .002$ ;  $F_2(1, 123) = 4.55, p = .035$ ). There was no interaction between head noun and noun type ( $F_1(2, 52) < 1$ ;  $F_2(2, 123) = < 1$ ) or match and noun type ( $F_1(2, 52) < 1$ ;  $F_2(2, 123) = < 1$ ), nor even an interaction between head and match as demonstrated above ( $F_1(1, 53) < 1$ ;  $F_2(1, 123) < 1$ ).

<sup>2</sup>Note that some of the collective nouns may also be taken to be animate, but this additional classification is not explored, as this feature is manipulated in the human group, and the point of interest is the fact that there is both semantic and grammatical gender which may clash, whereas in the collectives, it is the clash of number values in which we are interested.

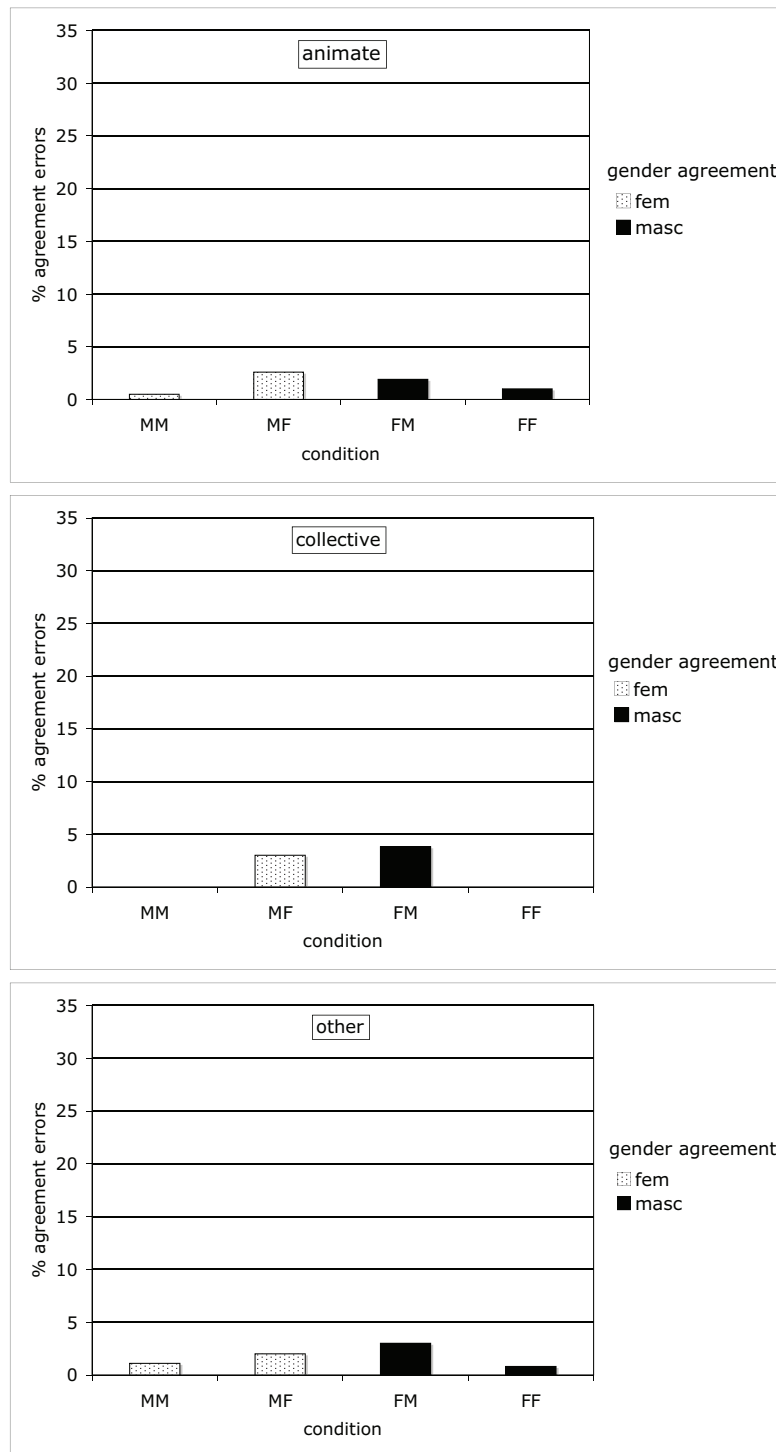


Figure 4.4: Experiment 5 - masculine and feminine agreement errors for masculine and feminine heads - by noun type

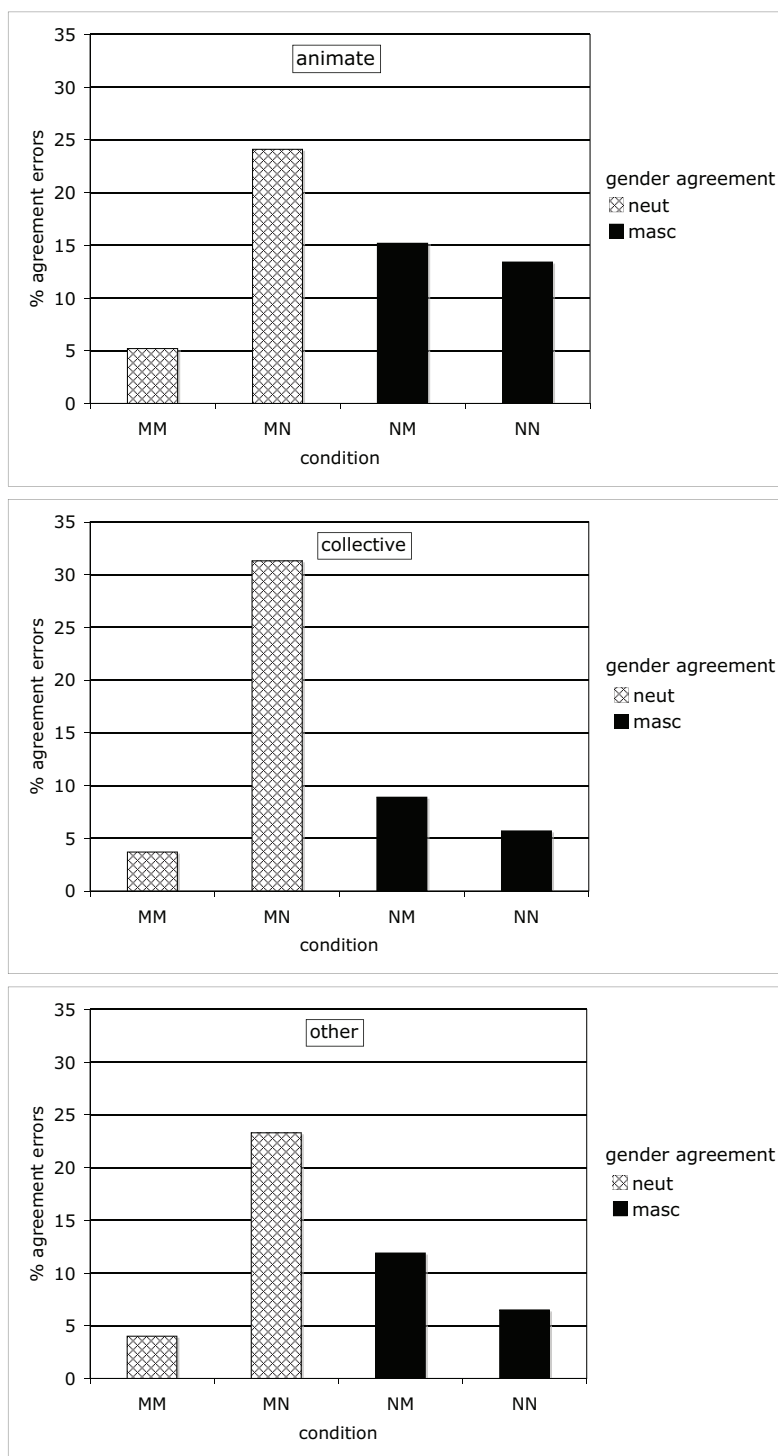


Figure 4.5: Experiment 5 - neuter and masculine agreement errors for neuter and masculine heads - by noun type

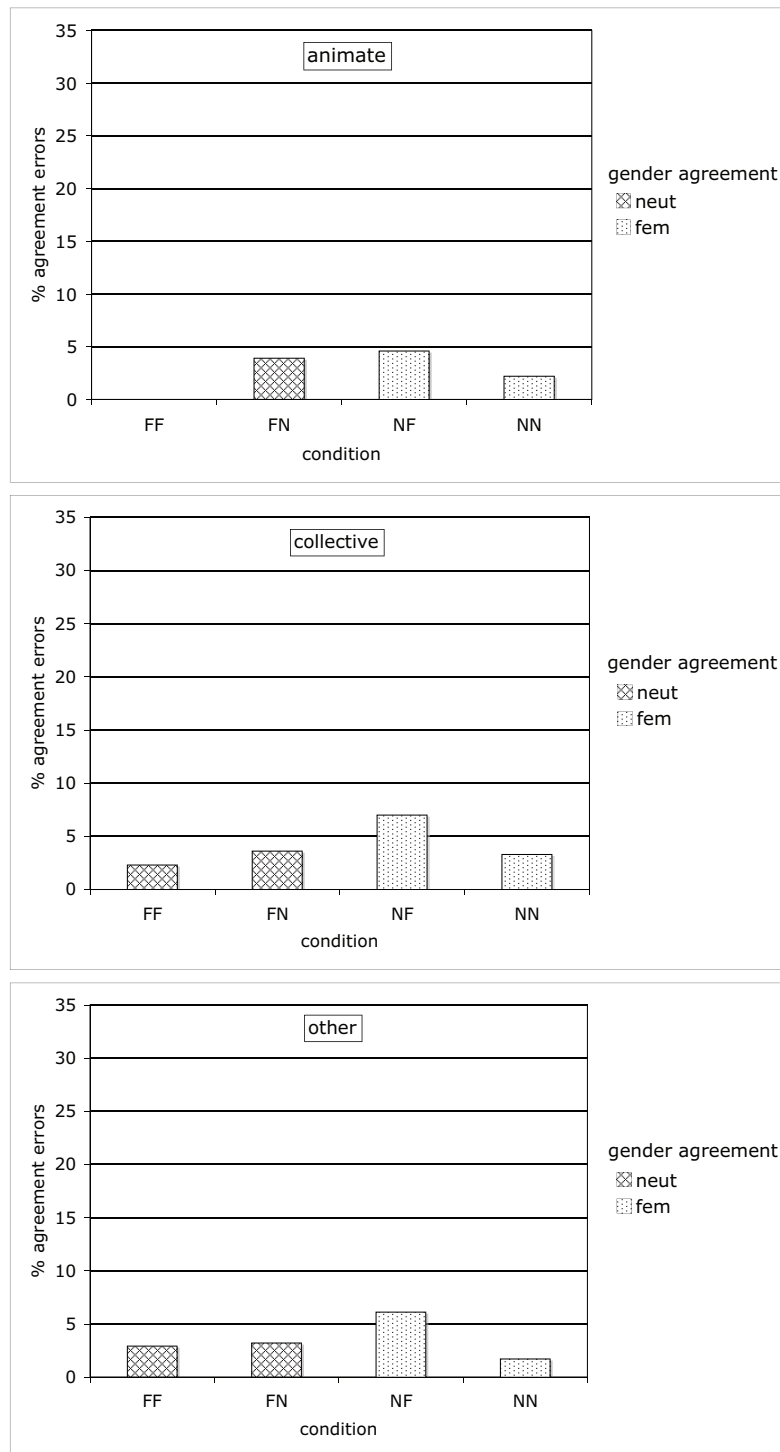


Figure 4.6: Experiment 5 - neuter and feminine agreement errors for neuter and feminine heads - by noun type

Noun gender (head noun, local noun)									
Type	human								
response	MM	MF	MN	FM	FF	FN	NM	NF	NN
fem	0.5	2.6	0	98.1	99.0	95.1	1.4	4.6	2.2
masc	94.4	90.7	75.9	1.9	1.0	1.0	15.2	11.3	13.4
neut	5.2	6.7	24.1	0.5	0	3.9	83.3	84.1	84.4
Type	collective								
response	MM	MF	MN	FM	FF	FN	NM	NF	NN
fem	0	3.0	2.3	96.2	97.7	93.4	4.0	7.0	3.3
masc	96.3	91.7	66.4	3.8	0	2.9	8.9	3.9	5.7
neut	3.7	5.3	31.3	0	2.3	3.6	87.1	89.1	91.1
Type	other								
response	MM	MF	MN	FM	FF	FN	NM	NF	NN
fem	1.1	2.0	2.4	96.2	96.3	95.6	1.5	6.1	1.7
masc	94.9	95.3	74.3	3.0	0.8	1.2	11.9	5.7	6.5
neut	4.0	2.7	23.3	0.8	2.9	3.2	86.7	88.2	91.8

Table 4.4: Experiment 5 - percentages of all gender agreement produced, divided by noun type

#### *Masculine / Neuter*

The results are shown in Figure 4.5. There was no effect of noun type ( $F_1(2, 52) = 1.42, p > .1$ ) and no interaction between head noun, match and noun type ( $F_1(2, 52) = 1.52, p > .1; F_2(2, 123) < 1$ ). There was an effect of head noun ( $F_1(1, 53) = 6.24, p < .02; F_2(1, 123) = 2.75, p > .1$ ) and local noun ( $F_1(1, 53) = 75.08, p < .001; F_2(1, 123) = 59.43, p < .001$ ). There was also a slight interaction between head noun and noun type significant by participants only ( $F_1(2, 52) = 3.85, p < .03; F_2(2, 123) = 1.55, p > .1$ ), but no interaction between match and noun type ( $F_1(2, 52) = 1.10, p > .1; F_2(2, 123) = 1.67, p > .1$ ), and head noun did interact with match ( $F_1(1, 53) = 26.62, p < .001; F_2(1, 123) = 31.51, p < .001$ ).

#### *Neuter / Feminine*

The results are shown in Figure 4.6. There was no effect of noun type ( $F_1(2, 52) < 1$ ) and a very marginal interaction between head noun, local noun and noun type ( $F_1(2, 52) = 2.51, p = .091; F_2(2, 123) = 2.93, p = .057$ ). There was no effect of head noun ( $F_1(1, 53) < 1; F_2(1, 123) = 2.29, p > .1$ ) but an effect of local noun ( $F_1(1, 53) = 8.54, p = .005; F_2(1, 123) = 6.29, p < .02$ ). There was no interaction between head noun ( $F_1(2, 52) < 1; F_2(2, 123) < 1$ ) or match ( $F_1(2, 52) < 1; F_2(2, 123) < 1$ ) and noun type, nor was there even head noun interacting with match ( $F_1(1, 53) < 1; F_2(1, 123) < 1$ ).

#### 4.2.9 Discussion

Experiment 5 shows that attraction errors occur in gender as well as number. This adds to previous work (e.g., Franck et al., 1999; Hupet, Fayol & Scheltraete, 1998; Kempe & Vigliocco, 2001; Meyer & Bock, 1999; Vigliocco et al., 1999; Vigliocco & Franck, 1999, 2001; Vigliocco & Zilli, 1999; Vigliocco et al., 2002a), which (with the exception perhaps of Badecker and Kuminiak (2007)) has concentrated on morphophonological and / or semantic effects. These findings are interesting because they are not semantically- (discourse-)driven, but are purely arbitrary.

Furthermore, these findings relate to a tripartite system of gender. Previous gender agreement investigations have been limited to a bipartite gender system (e.g., Franck et al., 1999; Hupet, Fayol & Scheltraete, 1998; Kempe & Vigliocco, 2001; Meyer & Bock, 1999; Vigliocco et al., 1999; Vigliocco & Franck, 1999, 2001; Vigliocco & Zilli, 1999; Vigliocco et al., 2002a) or have only investigated two of the three possible genders available in the language (Hemforth and Konieczny, 2003) or two of the possible oppositions Badecker and Kuminiak (2007).

Experiment 5 allows us to compare agreement patterns in gender and in number for the first time within the same language without the confound of having only two values.

When the head was masculine or feminine, there was a slight tendency towards more agreement errors after a feminine head noun but, importantly, participants were more likely to produce masculine or feminine attraction errors than to produce analogous agreement errors when the head and local noun matched. Participants were not more likely to produce masculine than feminine attraction errors.

There were slightly more agreement errors when the head noun was masculine than when it was neuter. There were significantly more agreement errors after a mismatching than a matching local noun when the nouns were masculine or neuter. Participants were more likely to produce neuter than masculine attraction errors.

Whether the head was neuter or feminine did not matter for the production of neuter or feminine agreement errors, but there were significantly more agreement errors after a mismatching than a matching local noun when the nouns

were masculine or neuter. Participants were not more likely to produce neuter than feminine attraction errors.

Overall, then, as well as the head noun controlling agreement, the local noun, to a lesser extent, did so too, but this was most significant in the case of masculine and neuter nouns. Unlike in number agreement, where we saw (in Chapter 2) that susceptibility and attractiveness may be dissociated, in gender agreement, the neuter and masculine are both more susceptible to attraction and more likely to cause attraction, in similar degrees. Like in number agreement, the masculine and neuter are not universally error-prone or error-inducing, but are susceptible and confusing to each other, whereas the feminine is both unlikely to cause errors for either masculine or neuter and not very susceptible to errors from either masculine or neuter.

Experiment 5 had four aims. The first was to investigate whether gender agreement functions in the same way as number agreement, and, more precisely, whether the lexicalised nature of gender (Levelt et al., 1999) means that its production differs to that of number agreement (Zubin and Köpcke, 1981, 1986). There are considerably more number than gender agreement errors, which suggests that there may be (at least) two independent agreement mechanisms (Vigliocco et al., 1996a; Antón-Méndez et al., 2002). However, the pattern of errors was similar to that found in the previous experiments.

Furthermore, the concept of markedness has been argued to elucidate the workings of number agreement, but is contentious in the area of gender agreement (Vigliocco and Franck, 1999, 2001; Vigliocco and Zilli, 1999; Hartsuiker et al., 2003; Meyer and Bock, 1999). It is not universally agreed amongst linguists which gender would be the unmarked one (Corbett, 1991; Moravcsik, 1978; Schane, 1970; Blevins, 2000; Jakobson, 1960). A further research question was therefore whether or not there appears to be evidence of markedness in patterns of gender agreement in Slovene, and if so, which gender is the unmarked one.

Experiment 5 also set out to test the reversion to the default form hypothesis proposed by Vigliocco and Franck (2001). According to this idea, assuming that we could resolve the default to being masculine or neuter (perhaps masculine for animate or at least human nouns and neuter for others; at any rate, only the feminine has not been proposed as a default gender), then we would have expected the feminine to be susceptible to errors. However, the feminine is a slightly stronger attractor than the neuter, and is about equal to the masculine.

Nor is it the case that the feminine is not the strongest attractor because it causes a lot of random errors in the control conditions; there are few errors associated with the feminine.

The neuter is the strongest attractor overall. This is entirely due to its potent influence on the masculine. The masculine is the second strongest attractor overall. This is mainly due to its (slightly less) potent influence on the neuter. The feminine is not a potent attractor. Although the masculine was highly susceptible to only neuter attraction errors, this made it the most susceptible to attraction overall. Whilst the neuter showed little variation in susceptibility, being susceptible to errors from both other genders, it was much more susceptible to masculine than feminine errors. Since the pattern of attractiveness in gender was feminine < masculine < neuter whereas the pattern of susceptibility was feminine < neuter < masculine, it is clear that in gender, as well as in number, these two must be dissociated. As in the analogous experiment on Slovene number, Experiment 2, it is clear that once random errors have been factored out, susceptibility is not inversely related to attractiveness - in fact, the feminine is both relatively powerless and relatively stable. This is analogous to the position of the singular in number agreement, except that the singular is associated with high random error rates, and this is not the case with the feminine. The masculine and neuter seem to be more confusable, since they are associated with more reciprocal errors. This is analogous to the dual and plural in number agreement. It is clear that we cannot understand agreement processing by looking at error rates if we cannot dissociate the random errors from the attraction errors, therefore we need to take into account the strength of head noun as well as the strength of the attractor.

The starkest effect is that neuter attraction effects are much stronger than masculine attraction effects. This is consistent with the idea that the neuter is more marked in Slovene, and is inconsistent with the pervasive claim that the neuter is unmarked (Blevins, 2000; Jakobson, 1960). This contrasts (albeit Dutch has only two genders) with Meyer & Bock's (1999) findings that in Dutch, the common noun is the stronger attractor and the neuter the weaker. Not only does this suggest that a simple markedness explanation cannot work for gender agreement, but it is also not consistent with a reversion to default explanation, whereby one gender is the default and when a speaker is having processing difficulties, they merely produce that gender. Although there is no consensus on whether the

neuter or the masculine is the default, there is certainly no claim that the feminine is the default. However, there is no obvious reversion to either of these forms as a default when the head is feminine. In fact, as stated above, the feminine is the least susceptible to agreement errors overall.

Further evidence against a reversion to the default explanation comes from the fact that masculine and feminine attraction effects do not differ: I failed to replicate Vigliocco and Franck's (1999) finding that feminine heads are more susceptible to masculine attraction than masculine heads are to feminine attraction. However it is possible that a 3-way gender system functions differently to a 2-way system (note that Slovene is more similar to Italian than Icelandic, in that the neuter is only used for neuter, not for mixed agreement in coordination).

Overall, then, I found that the evidence did not support the hypothesis that gender works on the basis of reversion to default(s). The data provided some support for markedness (with neuter marked compared to masculine, and feminine marked compared to neuter), but the data again cause difficulties for existing markedness models. There is certainly no evidence of a universally-applicable cline of markedness.

Meyer and Bock (1999) argued against a purely conceptual process of gender agreement, and against the influence of morphophonology (in the form of determiners), suggesting that gender agreement for pronouns is primarily lexical. Similarly, I have found that the linguistic features of the controller are used in order to calculate agreement. Determiners do not exist in Slovene, so they are certainly not used, but the fact that the masculine is morphophonologically unmarked and yet does not have an obviously special status compared to the feminine and the neuter argues against a morphophonological explanation. Arguably, however, the similarity of the masculine and neuter nouns (both use the same object clitic, associated with the head noun, in object relative clauses) may influence their agreement processing, since the masculine and neuter do show similarities (mutual susceptibility to attraction errors). I find no evidence for the use of semantic features alone, which would have caused more errors in the human than the other conditions, with neuter gender being replaced by masculine or feminine. In a number of the neuter head noun cases (e.g., *dekle* 'girl'), the semantics of the head noun could have led to feminine agreement, yet there were fewer incidences of feminine agreement than in the other groups overall. This finding runs contrary to the prediction that semantics would be used in agreement processing for nouns with semantic as well as grammatical gender (and is

consistent with Meyer & Bock's (1999) findings, although we must bear in mind that I was not addressing this issue directly).

A related question is whether different types of noun are processed differently. The results here were inconclusive. It is probable that the group analyses suffered from a lack of power. In all cases, there were numerically more errors in the mismatch than in the match conditions. Overall, the results for individual groups were similar to those found for the data as a whole, but there were some differences. Since collective nouns are most commonly neuter, and least commonly masculine, they are subject to most attraction from the masculine gender, which is most marked. Nouns denoting humans have grammatical gender which may or may not match the semantic gender denoted were predicted to be associated with more neuter attraction errors, since neuter is the most marked form for nouns denoting humans and the highest rate of neuter attraction was found in the human group for feminine heads, although neuter attraction rates were not much stronger on masculine heads than in other groups. Items are classified as human if one element is human. However, there are few items (e.g., 235) with a human head and a nonhuman local noun due to the nature of the materials: the local noun is an agent of a transitive verb within the relative clause whereas the head noun is merely the agent of an intransitive verb in the main clause, therefore there are few preambles with an inanimate agent and an animate patient of the transitive verb. More controlled testing would be required to establish whether there are indeed differences between different types of nouns, as I did not distinguish between head and local nouns in the analysis due to sparsity of data.

(235) revše, ki ga je mikalo pleče  
 wretch which OBJ AUX tempt.PPL ham  
 'a wretch whom ham tempted'

There are more attraction and random errors after an item with head and local noun mismatching in animacy compared to items with head and local nouns that are both human, suggesting that the potential ambiguity which human nouns bring between grammatical and conceptual gender is not additive, but rather, that it is the difference in animacy between the head and local noun which may be driving the effects. Bock & Miller (1991) concluded that animacy had no effect on agreement, and this question has been subsequently abandoned in favour of the broader question of whether the noun is a plausible subject of the verb, so

it is interesting to note this difference, which suggests that animacy may have an effect after all. The masculine is clearly a more obvious default for a feminine human noun than the neuter (whereas the neuter is more often used for non-humans, examples detailed above notwithstanding). Interestingly, although there is a stronger neuter attraction effect on the feminine and more neuter than masculine errors after a feminine head overall, there are more masculine random agreement errors (i.e. errors occurring in the two conditions without a masculine local noun) following a feminine head than there are neuter random agreement errors (i.e. errors occurring in the two conditions without a neuter local noun). It must be said that these random masculine errors are not higher than in the collapsed group. This is rather weak evidence for a reversion to the default explanation, but the neuter attraction effect on the feminine still requires an explanation. There are also extremely high proportions of masculine random errors in the neuter head conditions without a neuter local noun. These errors are much higher than in the collapsed group, and account for the lack of masculine attraction effects after a neuter head. This is evidence for a reversion to the default explanation.

It is clear that collective nouns have a special status as regards number, but considering the possible influence of semantics on gender assignment (Corbett, 2006; Schwichtenberg and Schiller, 2004), it is possible that they also differ from non-collectives in terms of gender. Collectives are rarely masculine. It is thus possible to state that for collectives, the masculine is a marked gender.

In the group containing collective nouns, the neuter errors after a masculine head noun are proportionally much higher than in the other two (larger) groups. There are also trends towards masculine attraction effects with a feminine head noun, feminine attraction effects with a masculine head noun, and feminine attraction effects with a neuter head noun. Although the effects are less than convincing, it is notable that masculine collectives are more susceptible to feminine attraction than other groups. This suggests that masculine collective nouns are somehow unstable (this is against markedness, since the masculine is more marked for collectives).

Overall, there is some evidence for markedness (especially with respect to ambiguous human nouns) and some evidence for reversion to a default (masculine in the case of ambiguous human nouns, neuter for collectives).

Experiment 5 is important because it demonstrates an important role for semantics within the computation of gender agreement. One might expect differences with human nouns with relation to gender, since their ambiguity is precisely defined in terms of a relationship between biological (conceptual) and grammatical gender, but importantly, I have shown that agreement differs in different types of noun, even when gender is apparently irrelevant, as in the case of collective nouns. This suggests that the grammatical gender of nouns is not entirely arbitrary, but is intricately bound up in the semantics of the noun, and therefore that semantics and syntax both play a crucial role in agreement processing.

Furthermore, it is clear that languages with grammatical gender need to be studied in order to find out more about agreement processing. Though number is interesting, number agreement processing seems to work differently to gender agreement processing, so we need to study both in order to find out how agreement works in order to develop a comprehensive model of agreement processing in language production. I have already argued in favour of more exploration of languages with a more complex number system than those usually favoured by psycholinguists, and I would reiterate that with respect to gender. Whilst it is arguably difficult to find large groups of participants who speak languages with more complex number systems than Slovene, the same cannot be said of gender. Work on gender has been restricted to the investigation of two genders, and they have usually been investigated indirectly, yet theoretical linguists have long stressed the importance of exploring more complex gender systems. Indeed, interesting though it is to compare the portmanteau morphemes of Slovene with agglutinative number and gender morphemes (as in Spanish), if we were to study languages in which there are a larger number of genders (such as Swahili), we might discover other ways in which gender and number interact.

## CHAPTER 5

# Conjuncts

### 5.1 Introduction

As argued in Chapter 1, agreement is often assumed by psycholinguists to be a syntactic process, with no influence from other areas of language production (Bock and Levelt, 1994); furthermore, it has been claimed that it occurs at the level of functional processing, before word order is determined. However, the experiments reported in Chapter 3 (and other studies such as Hartsuiker et al., 2003) provide evidence against the first of these claims, by demonstrating that semantics (and phonological form) influence agreement. In this chapter I will examine further how semantics might influence agreement. Additionally, I will examine whether the second claim, that agreement is determined at a level of processing that is unordered, can be supported. Specifically, I will report four experiments that examine agreement following coordinated subject NPs. In Experiments 6 and 7, I examine agreement following conjuncts<sup>1</sup> that match or mismatch in number; in Experiments 8 and 9, I examine agreement following coordinands that match or mismatch in gender. Note that one advantage of examining agreement with coordinated phrases is that ‘normal’ agreement (as opposed to errors, as in the experiments reported in previous chapters) may be observed.

The experiments also manipulate the coordinator, with Experiments 6 and 8 investigating agreement following disjunctive subject NPs that contain ‘or’, and Experiments 7 and 9 investigating agreement following conjunctive subject NPs that contain ‘and’. If agreement is influenced by coordinator, this would provide

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<sup>1</sup>The term conjunct is used to refer to one of the coordinated phrases, whether the coordination as a whole constitutes conjunctive coordination or disjunctive coordination.

further evidence that semantics affects agreement. If agreement is also affected by linear order, such that agreement is affected by the relative order of coordinands, this would suggest that agreement cannot be determined at a stage of processing prior to the determination of linear order. In other words, it would argue against accounts of agreement that place it strictly at the functional level. Even more interestingly, these experiments could cast light on any interaction between semantic and ordering effects in agreement: if semantics can only affect the message level and the level directly following the message level (i.e., functional processing), then we would not expect it to interact with any effect of linear order on agreement processing.

### 5.1.1 Previous research

#### *Single conjunct agreement*

Coordination is an interesting area to explore with regard to agreement, since there is much debate on this in the theoretical linguistics literature but little in psycholinguistics. With a coordinated phrase as a subject, speakers may produce “single conjunct agreement”, which refers to the tendency for the verb to agree with only one of the conjoined nouns in subject position (e.g., singular agreement), as opposed to “resolved agreement”, whereby the verb’s features may match the combination of the conjuncts (e.g., plural agreement).

Sometimes also called “partial agreement” since it involves agreement with only one part of a coordinated phrase, single conjunct agreement refers to the tendency, observed in Arabic Example 42, repeated here as 236, for the verb to agree in gender and number with only one of the conjoined nouns in subject position. In contrast, “resolved agreement” involves matching the combination of the conjuncts rather than just one conjunct, as in Example 237 from Icelandic, where both conjuncts are singular (the verbal agreement is plural) and are masculine and feminine (the verbal agreement is neuter).

- (236) darasa kariim wa-widaad al-'arabiiya  
 studied.M.SG karim.M and-widaad.F the-Arabic  
 ‘Karim and Widad studied Arabic’
- (237) drengurinn og telpan eru þreytt  
 the.boy.M and the.girl.F are tired.N.PL  
 ‘the boy and the girl are tired’

The order of the conjuncts (e.g., *Karim* or *Widad*, ‘boy’ or ‘girl’) may affect agreement in two different ways. First, as discussed earlier (Chapter 1), it is the word order (more specifically, whether the subject precedes or follows the verb) which triggers whether agreement is with a single conjunct or is resolved. Not only that, but where agreement is with a single conjunct, linear order affects agreement, the verb agreeing with the nearest conjunct. In Example 236, the verb agrees with the adjacent masculine conjunct, whereas in Example 238, the verb agrees with the adjacent feminine conjunct.

- (238) *darasat widaad wa-kariim al-'arabiiya*  
 studied.F.SG widaad.F and-kariim.M the-arabic  
 ‘Widad and Karim studied Arabic’

Since single-conjunct agreement occurs most often in VS word order, it has also been called “first conjunct agreement”. The phenomenon is also commonly termed “nearest conjunct agreement”. In VS word order, we cannot differentiate between these different types of partial / single-conjunct agreement, but in SV word order, they are opposed. There is some evidence for nearest conjunct agreement in languages with SV word order, but it is not unequivocal.

#### *Slovene single-conjunct agreement*

In Slovene, it is generally accepted that single-conjunct agreement exists under certain circumstances. Bajec et al. (1956) state that when conjuncts are in the same semantic sphere, they are taken “as a whole” [my translation] and the gender of the subject complement conforms with the nearest word. This is equally true of number, which may be identical to that of the nearest conjunct, e.g.,

- (239) *groza in strah je prevzel vso vas*  
 horror.F and fear.M AUX.SG taken.over.SG.M whole village  
 ‘Horror and fear has taken over the whole village’

In this case, the agreement is with the nearest conjunct. Slovene is famously also claimed to have “furthest conjunct”<sup>2</sup> agreement (Corbett, 1983), e.g. (from

<sup>2</sup>Johannessen (1996) analyses such agreement as furthest-conjunct agreement. The analysis rests on the assumption that agreement depends on whether the language is head-initial or head-final. Since Slovene is also head-initial, this means that “the non-agreeing conjunct will be in the same position relative to the conjunction as other complements are to their heads”, thus only first conjunct agreement and not second conjunct agreement is possible.

Corbett, 1983),

- (240) *groza in strah je prevzel-a vso vas*  
 horror.F and fear.M AUX.SG taken.over-SG.F whole village  
 ‘Horror and fear has taken over whole village’

It should be noted that although this example is well-attested, it is not clear whether this phenomenon is to be seen in other types of sentences, and *groza in strah* is seen by many native speakers as a collocated phrase (i.e., it may only be applicable to expressions which are somewhat fixed). Furthermore, the opposite order *strah in groza* is actually more common (see Appendix J). This shows therefore that not only is the question of nearest-conjunct agreement a contentious one in general, but it is further complicated in Slovene by the possibility of the existence of furthest-conjunct agreement.

There is little consensus in theoretical linguistics as to how to account for coordination. The classic linguistic account of coordination (Chomsky, 1957) involves the assumption of parallelism:

If S1 and S2 are grammatical sentences, and S1 differs from S2 only in that X appears in S1 where Y appears in S2 (i.e. S1= ...X... and S2=...Y...) and X and Y are constituents of the same type in S1 and S2, respectively, then S3 is a sentence, where S3 is the result of replacing X by X+and+Y in S1 (i.e. S3=... X+and+Y...).

Thus according to Coordinate Reduction Transformation,  $X \rightarrow X \text{ and } X$ . Similarly, theoretical linguists working in other frameworks (CCG, LFG) do not assume asymmetric agreement, since it is unnecessary for these accounts (e.g., Wechsler and Zlatić, 2000), but the current Chomskian account of coordination involves the assumptions that one coordinand is subservient to (C-commanded by) the other, that each coordinand has the same structural properties as if it were not conjoined (licensing symmetry), and that coordination always involves a set of sentential functional projections (Chomsky, 1995). According to this account, the first coordinand is structurally superior to the second (or subsequent) coordinand(s).

*Semantics of coordination*

We have so far assumed that coordination does not differ with respect to coordinator. Traditionally, conjunction and disjunction are treated symmetrically using the standard Boolean definitions (Gazdar, 1980; Partee and Rooth, 1983; Keenan and Faltz, 1985). Equally, it has also been suggested (Larson, 1985; Winter, 1995, 1998) that conjunction and disjunction have different scopes. Either way, it is indisputable that they have different semantics (Dik, 1968). Both are coordinating conjunctions; they link constituents of equal functional status. However, whilst conjunctions combine two (or more) elements, disjunctions offer a choice between two (or more) elements. Disjunctions can be inclusive (essentially offering combination or choice) or exclusive (offering just a choice); this ambiguity suggests more logical complexity. However, Johansson (1977) investigated the relative difficulty children had with the terms 'and' and 'or'. He found that whilst the terms were not found to differ in their degree of difficulty, participants' ability to perform logical tasks was affected by which term was used; namely, disjunctions were more difficult.

Having seen that semantics affects agreement (in Chapter 3), we might expect that the differences between coordinators ('and' and 'or') would also have an influence on the agreement produced after a coordinated noun phrase. Whilst conjunctions are expected to result in resolved agreement, disjunctions are associated with single-conjunct agreement, presumably because since both coordinands are not necessarily necessary, agreement with one of them is more acceptable.

Past research has been divided as to whether semantics of the nouns in question can affect word order in coordination. Although psycholinguists have searched for evidence that the semantics of conjuncts can affect word order in the same way that the semantics of agent and patient can (Bock et al., 1992; Ferreira, 1994; McDonald et al., 1993; Van Nice and Dietrich, 2003; Prat-Sala, 1997), McDonald et al. (1993) found no tendency for participants to recall animate before inanimate conjuncts, and Bock and Warren (1985) failed to find that concrete conjuncts to precede abstract conjuncts. Tanaka et al. (2005) examined sentence recall for Japanese sentences involving NP conjunctions and for transitive sentences. They found that while in transitive sentences, word order in recall was affected by animacy, conjunct order was not significantly affected by animacy. This suggests that coordinated noun phrases may be processed differently from other syntactic

structures (Branigan et al., 2008), but that there may be a more limited role for semantics affecting word order in coordination.

*Psycholinguistic research into linear order effects*

Vigliocco and Nicol (1998) claimed that linear proximity had no effect on agreement, since “The helicopter for the flights” produced similar attraction error rates when participants were asked to produce interrogatives (Example 241) or declaratives (Example 242) (as discussed above in Chapter 1) despite the local<sup>3</sup> noun being further away in linear distance in the interrogatives than in the declarative sentences. Vigliocco and Nicol (1998) take this evidence to show that the local noun percolates through to influence agreement through the syntactic hierarchy irrespective of linear distance, since it is equidistant from both structurally.

(241) Is the helicopter for the flights safe?

(242) The helicopter for the flights is safe

However, there is some suggestion that order can affect agreement. Franck et al. (2006) investigated whether subject-verb word order in which the local noun was intervening between the head noun and the verb (e.g., Example 243) caused more agreement errors than verb-subject word order in which the local noun did not intervene between the head noun and the verb (e.g., Example 244).

(243) gli amici de-lla sorella parte  
 the.PL.M friend.PL.M of-SG.F sister.SG.F leave.SG  
 ‘The sister’s friends leave’

(244) parte gli amici de-lla sorella  
 leave.SG the.PL.M friend.PL.M of-SG.F sister.SG.F  
 ‘The sister’s friends leave’

The authors’ interpretation is more complex, relying on movement from the same underlying structure (whereas they claim that the underlying structure of English interrogatives and declaratives is identical, which would explain the findings of Vigliocco & Nicol, 1998), but for those not assuming syntactic transformations, we may take this as evidence that linear word order affects agreement.

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<sup>3</sup>Here, the noun is structurally local, according to their account, although for a linear account, it is more distant in the interrogative than the head noun.

Haskell and MacDonald (2005) used coordinated phrases to investigate whether linear order affects agreement. With a coordinated phrase as a subject, speakers may produce single conjunct agreement or resolved agreement. They had participants produce sentences like Example 245 (subject-verb word order) and 246 (verb-subject word order). They found that participants displayed a preference for nearest-conjunct agreement, and they also found that the proximity effect was significantly larger in the verb-subject than the subject-verb condition, thus arguing for a proximity-based account.

(245) Can you tell me whether the hat or the gloves is/are red?

(246) Is/Are the hat or the gloves red?

Nearest-conjunct agreement is very interesting for psycholinguistic accounts of agreement production because word order is often assumed to be decided after agreement has been computed (Bock and Levelt, 1994), yet word order may affect agreement both in terms of whether it is resolved rather than inducing single-conjunct agreement (which may be dictated by whether the subject precedes or follows the verb), and in terms of which coordinand the verb agrees with when it agrees with only one. Haskell and MacDonald (2005) argued that “nearest conjunct” agreement gives support for some kind of adjacency-based production, since the choice of linear order of the coordinands is assumed to be unrelated to their semantics or syntax.

Another psycholinguistic investigation of coordinated phrases was conducted by Timmermans et al. (2004), who examined the role of linear proximity in the production of (second versus third) person agreement in Dutch (and in German). They found no difference in person agreement between preambles like Example 247 and 248, but equal rates of third person agreement and second person agreement in both conditions, irrespective of conjunct order.

(247) jij en de jongen  
you.SG and the boy.SG  
'you and the boy'

(248) de jongen en jij  
the boy.SG and you.SG  
'the boy and you'

Interestingly, what they observed in the case of third person agreement (which was the most common response) was not single conjunct agreement, because the third person element is singular, but a combination of resolution in number agreement (with two singular conjuncts being resolved to plural agreement) and single-conjunct agreement in person agreement (in the case of second person agreement, agreement is ambiguous between single conjunct and resolved agreement, but in the case of third person agreement, the only available explanations are single conjunct agreement or reversion to a default). Their findings imply that there is no influence of linear order, although this may be due to their use of conjunctive coordination, or because the type of agreement in question is person agreement.

Hemforth and Konieczny (2003) examined agreement in written German using disjunctive declaratives as well as interrogatives. They found that verb number agreement was strongly influenced by linear order; indeed, they refer to both singular and plural as being “acceptable” when the local noun is marked as singular. They also did comparable experiments with other grammatical constructions, but failed to find linear effects in object attraction. Although a proximity-based account is compatible with their disjunctives data, their results overall do not support a proximity account over a percolation-based one (in which the number of one noun percolates through the syntactic tree), except, as they observe, in the case where syntactic constraints are weak.

Vigliocco and Nicol (1998) propose that the agreement errors are caused by percolation up the syntactic hierarchy from the local noun to the subject NP. This explanation is untenable if agreement is influenced by linear word order because both coordinands would have an equal position in the hierarchy, so there would be no reason why the nearest one would influence agreement. Thus it is unclear in psycholinguistics whether linear proximity plays a role in agreement, but there is evidence that it may do so in the case of disjunctive coordinands at least. In order for agreement of coordinated phrases to inform the debate about whether linear word order (distinct from hierarchical structure) can influence agreement, it is necessary to assume, as we do, that the coordinands do not differ in their position in the structural hierarchy. However, there is great debate in the theoretical linguistics literature as to whether one of the coordinands, namely the first, is hierarchically superior to the other. If this is the case, then finding agreement with a single coordinand does not show that linear ordering is accessible

before syntactic processing, since the information regarding the ordering of the coordinands would be syntactic.

In keeping with previous work in psycholinguistics (e.g., Haskell and MacDonald, 2005; Hemforth and Konieczny, 2003) which does not accept that coordination is asymmetric, for the purpose of this thesis, it is assumed that the coordinands do not differ in status or hierarchical position.

Given the controversy in the psycholinguistic literature about which factors may influence syntactic processes such as agreement in general and agreement with coordinated phrases in particular, it is clearly fruitful to investigate further whether linear proximity affects agreement. Crucially, since it has a tripartite number system, Slovene allows us to investigate whether the verb agrees with the furthest coordinand, the nearest coordinand, or is resolved, since there are three possible number values. It is thus possible to separate out resolved number agreement from agreement with one of the coordinands, and yet to explore matching and mismatching coordinands.

### 5.1.2 *Experimental overview*

There have been numerous attempts to explain nearest conjunct agreement, as opposed to resolved agreement, which is usually considered the norm. It has been observed that nearest-conjunct agreement is most likely to occur if the verb precedes the conjuncts (Babyonyshev, 1996; Franks, 2005; McCloskey, 1989; Vassilieva, 2001; Haskell and MacDonald, 2005; Hemforth and Konieczny, 2003). This phenomenon has often been referred to as “first conjunct agreement”. Although pre-verbal nearest-conjunct agreement is commoner if post-verbal nearest-conjunct agreement also exists, any strategy proposed would need to account for both types of nearest-conjunct agreement. Haskell and MacDonald (2005) have shown that, at least in some circumstances, post-verbal nearest-conjunct agreement exists in English.

I therefore set out to discover whether there is evidence of single-conjunct agreement (and if so, whether with nearest or furthest conjunct) in Slovene, examining both number and gender. I first tested singular and dual coordinands with the disjunctive coordinator *ali* (‘or’). I then tested singular and plural coordinands with the coordinator *in* (‘and’), then I tested masculine and feminine coordinands with just the coordinator *in* (‘and’), then I tested masculine and feminine coordinands with both coordinators.

Condition	Sentence preamble	
sing-sing	Vojak ali mornar	Soldier or sailor
dual-sing	Vojaka ali mornar	(Two) soldiers or sailor
sing-dual	Vojak ali mornarja	Soldier or (two) sailors
dual-dual	Vojaka ali mornarja	(Two) soldiers or (two) sailors

Table 5.1: Experiment 6 materials

## 5.2 Coordinating Number Agreement

Slovene allows us to compare agreement after coordinated pairs which differ in number. The following experiments investigate whether different combinations of number induce different agreement production according to differing word order to ascertain whether the verb agrees with the furthest coordinand, the nearest coordinand, or is resolved. Since there are three possible number values in Slovene, it is possible to separate out resolved number agreement from agreement with one of the coordinands.

### 5.3 Experiment 6: Slovene disjunctive agreement - dual versus singular

Experiment 6 sought to investigate several questions: whether people actually produce single-conjunct agreement as is claimed, and if so, under what circumstances and furthermore, whether the agreement is with the furthest coordinand (as suggested by Corbett, 1983) or the nearest (as suggested by Bajec et al., 1956).

More importantly, this experiment sought to establish whether linear order can affect agreement. Experiment 6 compared agreement after coordinated pairs which differed in number. The number values of the two conjuncts could be singular or dual, and they could either match (e.g. ‘the soldier and the sailor’) or mismatch (e.g., ‘the soldiers and the sailor’). In order to maximise the possibility of single-conjunct agreement, following Haskell and MacDonald (2005) and Hemforth and Konieczny (2003), the disjunction *ali* ‘or’ was used.

#### 5.3.1 Predictions

Possible completions were singular or dual or plural, which could indicate agreement with one of the coordinands only or resolved agreement (i.e. agreement with the sum of the two conjuncts).

If linear order can affect agreement, then we would expect to find that in at least some cases, participants will produce agreement with only one of the conjuncts as opposed to the sum of both conjuncts, and that the agreement number will be dependent on the order (as in Example 249).

- (249) vojaka ali mornar je odšel  
 soldier.DU or sailor.SG AUX.SG leave.PPL  
 'The two soldiers or the sailor left'

This would suggest that agreement does not happen before word order is computed (Vigliocco and Nicol, 1998) or that word order information is available during agreement computation as well as after it.

Following Haskell and MacDonald (2005), we would expect that the second (nearest) conjunct is more important than the first (furthest) conjunct, such that there will be an effect of second conjunct and participants will be more likely to produce a predicate agreeing in number with the second conjunct than with the first. This would manifest itself as an effect of second conjunct. Alternatively, if any agreement except resolved agreement is with the first (furthest) conjunct, this would support the accounts of Corbett (1986) and Johannessen (1998). Since Slovene is also head-initial, this means that "the non-agreeing conjunct will be in the same position relative to the conjunction as other complements are to their heads", thus only first conjunct agreement and not second conjunct agreement is possible with SV word order (Johannessen, 1998). If there is both nearest- and furthest-conjunct agreement, then the effects may cancel each other out. Thus a null result would either mean different types of single-conjunct agreement, or a lack of linear word order effects.

More specifically, if linear order affects word order, then if agreement is with the nearest conjunct, there would be more dual agreement after a subject like 'a soldier and two sailors' compared to both 'a soldier and a sailor' and 'two soldiers and a sailor'. Similarly, there would be more singular agreement after a subject like 'two soldiers and a sailor' than after either 'two soldiers and two sailors' or 'a soldier and two sailors'. Alternatively, if agreement is with the furthest conjunct, then we would expect more dual agreement after a subject like 'two soldiers and a sailor' than after either 'two soldiers and two sailors' or 'a soldier and two sailors' and more singular agreement after a subject like 'a soldier and two sailors' compared to both 'a soldier and a sailor' and 'two soldiers and a sailor'. If linear order also affects resolved agreement, then we would expect

the two mixed conjuncts (e.g., ‘a soldier and two sailors’ and ‘two soldiers and a sailor’) to differ as to rates of plural agreement.

### 5.3.2 Method

#### *Procedure*

The procedure and participant pool was as in the previous experiments, except that there was no completion verb given; the participants were asked to complete the sentence using a verb of their own choosing (participants reported that they thought it was a free-association, psychiatric experiment). In the instructions, participants were given examples using the past tense to encourage the use of the past tense (where gender is evident) as opposed to the present tense (which is unspecified with regard to gender), in order to ensure that the experimenter knew which unambiguous form was being produced (e.g., singular agreement could be ambiguous between neuter singular generic and singular agreement with one singular conjunct) and to be consistent with the previous experiments. The examples were ambiguous between resolved and single conjunct agreement, e.g.,

- (250) jagode            in    maline            so            lepo    dišale  
 strawberry.PL and raspberry.PL AUX.PL good smelt.PL  
 ‘The strawberries and the raspberries smelt good’

The presentation times for the stimuli were thus as follows: fixation point (680ms), preamble (1400ms), series of dots moving across screen until warning tone (1360ms).

#### *Materials*

There were 16 items. Singular and dual conjuncts were employed. The experimental items crossed number (singular or dual) with position (first or second). Gender remained constant within items but across items varied, with half masculine and half feminine. The type of coordinator also remained constant across experimental items, with the disjunctive *ali* being used to increase the use of a strategy of agreeing with one conjunct rather than both. Fillers consisted of coordinands (singular masculine or feminine) with both the conjunctive *in* and the disjunctive coordinator *ali*. Example stimuli are shown in Table 5.1 and listed in Appendix F.3.

### *Participants*

There were 76 participants, all students at Ljubljana University, 11 male and 65 female. 42 were first-year students, 18 second-year, 10 third-year (including one mature student) and 6 were fourth-year or above.

### *5.3.3 Design and data analysis*

The major statistical tests were performed using the agreement produced in each gender as the dependent variable. Two analyses of variance were carried out, one with participants and one with experimental items as random factor. All effects that are reported as significant achieved significance at the .05 level or beyond. Errors are reported as proportions of all agreement to facilitate comparison between experiments. Planned pairwise comparisons were used to evaluate predicted differences between conditions, using the mean-square error of the relevant interactions from the participants and items analyses separately.

### *5.3.4 Results*

There were 1216 responses. I excluded one item (76 responses) that included a typographical error and 16 responses that were inaudible. I excluded one participant (16 responses) who failed to produce any correct preambles followed by agreement marking. I analysed the remaining 1108 responses as in Experiment 1. Of these, 771 involved a response with agreement marking. These 771 responses were analysed as proportions of all agreement marked responses produced in that condition. Where no response with agreement marking was produced in a particular condition (for a participant or for an item), the missing proportion was replaced with the relevant participant / item mean for that condition. This is because there are vast differences between the means for the different conditions (essentially, the normative value for an individual number value). 33 cells were replaced in the participants analysis, three in the items analysis.

The percentages are shown in Table 5.3 and also in Figure 5.1. Note that the charts in Chapter 5 only show the mismatch conditions (where the two conjuncts had different number or gender) and that they present all the agreement produced for each of these conditions. The responses including agreement are shown for each of the four conditions, where the first coordinand is singular and the second also

Response	Conjunct number (first conjunct, second conjunct)			
	sing-sing	sing-dual	dual-sing	dual-dual
sing	91	16	26	5
dual	127	124	107	162
plural	7	55	42	9

Table 5.2: Experiment 6 - raw responses of all agreement produced with 'or'

showing agreement for singular first conjuncts with singular and dual second conjuncts, and dual first conjuncts with singular and dual second conjuncts

singular (sing-sing), the first coordinand is singular and the second dual (sing-dual); the first coordinand is dual and the second singular (dual-sing); and where both coordinands are dual (dual-dual).

#### *Singular agreement*

There were main effects of first conjunct number ( $F_1(1, 74) = 32.89, p < .001$ ;  $F_2(1, 14) = 56.91, p < .001$ ), with more singular agreement after a singular than a dual first conjunct; and of second conjunct number ( $F_1(1, 74) = 47.17, p < .001$ ;  $F_2(1, 14) = 37.50, p < .001$ ), with more singular agreement after a singular than a dual second conjunct. Critically, there was an interaction between first and second conjunct number ( $F_1(1, 74) = 17.22, p < .001$ ;  $F_2(1, 14) = 23.12, p < .001$ ): participants were more likely to produce singular responses following a singular second conjunct than following a dual second conjunct when the first conjunct was also singular (32.2%) than when it was dual (12.0%) (sing-sing minus sing-dual = 32.2% versus dual-sing minus dual-dual = 12.0% difference).

Simple order effects were found in the mixed conjunct conditions (marginal by items): there were 6.6% more singular responses directly following a singular conjunct (dual-sing 15.8%) compared to directly following a dual conjunct (sing-dual 8.2%) ( $F_1(1, 74) = 5.41, p < .03$ ;  $F_2(1, 14) = 3.94, p = .067$ ).

#### *Dual agreement*

There were main effects of first conjunct number ( $F_1(1, 74) = 28.78, p < .001$ ;  $F_2(1, 14) = 51.42, p < .001$ ), whereby there were more dual responses after a dual first conjunct than after a singular first conjunct; and of second conjunct number ( $F_1(1, 74) = 24.86, p < .001$ ;  $F_2(1, 14) = 14.36, p = .001$ ), whereby there were more dual responses after a dual second conjunct than after a singular second conjunct. Critically, there was an interaction between first and second conjunct

Response	Conjunct number (first conjunct-second conjunct)			
	sing-sing	sing-dual	dual-sing	dual-dual
sing	40.4	8.2	14.8	2.8
dual	56.4	63.3	60.8	92.0
plural	3.1	28.1	23.9	5.1

Table 5.3: Experiment 6 - percentages of all agreement produced with 'or'

showing agreement for singular first conjuncts with singular and dual second conjuncts, and dual first conjuncts with singular and dual second conjuncts

number ( $F_1(1, 74) = 11.09, p = .002$ ;  $F_2(1, 14) = 7.09, p < .02$ ): participants were more likely to produce dual responses following a dual second conjunct than following a singular second conjunct when the first conjunct was also dual (31.2%) than when it was singular (6.9%) (dual-dual minus dual-sing versus sing-dual minus sing-sing).

There were no simple order effects (all  $F_s < 1$ ) in the mixed conjunct conditions; although as is clear from Figure 5.1, there were numerically more dual responses directly following a dual compared to directly following a singular (sing-dual 63.3% minus dual-sing 60.8%), the 2.5% difference was not significant.

#### *Plural agreement*

There were no main effects of first conjunct number ( $F_1(1, 74) = 1.02, p > .1$ ;  $F_2 < 1$ ) or second conjunct number ( $F_1(1, 74) = 2.41, p > .1$ ;  $F_2(1, 14) = 2.92, p > .1$ ). Critically, there was an interaction between first and second conjunct number ( $F_1(1, 74) = 48.43, p < .001$ ;  $F_2(1, 14) = 37.61, p < .001$ ): participants were more likely to produce plural responses following a dual second conjunct than following a singular second conjunct when the first conjunct was a singular (25%), but were more likely to produce plural responses following a singular second conjunct when the first conjunct was dual (-18.8%) (sing-dual minus sing-sing versus dual-dual minus dual-sing).

There were no simple order effects in the mixed conjunct conditions; although there were numerically more plural responses directly following a dual compared to directly following a singular (sing-dual 63.3% minus dual-sing 60.8%), the 2.5% difference was not significant ( $F_1(1, 74) = 1.90, p > .1$ ;  $F_2(1, 14) = 1.76, p > .1$ ).

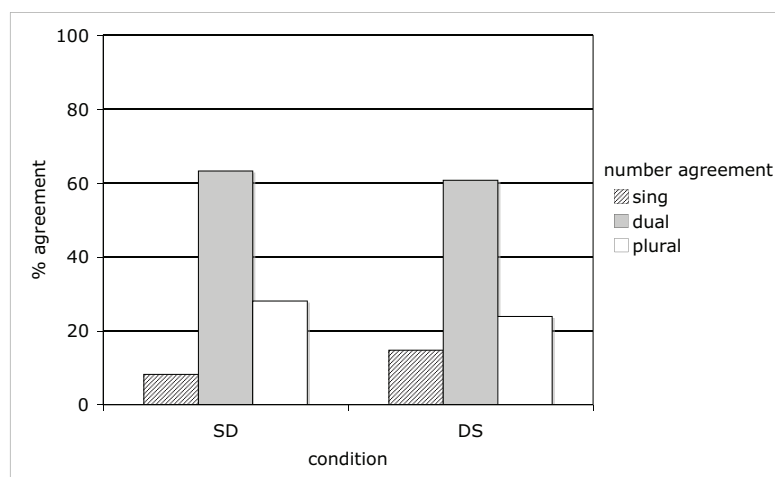


Figure 5.1: Experiment 6 - all agreement produced for mixed (sing-dual and dual-sing) conjuncts

showing agreement for singular and dual heads (dual and singular local nouns)

### 5.3.5 Discussion

This experiment set out to test what kinds of patterns of agreement Slovene speakers produce after conjoined NPs and crucially whether or not there is an effect of linear word order on agreement. First, and most basically, Experiment 6 provided evidence that elucidates theoretical linguistic accounts of Slovene. It was found that the number of the coordinands did have an effect on the rate of single-conjunct agreement when coordinands were singular and dual and included a conjunction (*ali* 'or'). Specifically, participants were particularly likely to produce singular agreement when both coordinands were singular, and dual agreement when both coordinands were dual. In contrast, plural agreement was most common when the coordinands mismatched.

Experiment 6 provides evidence for more than one agreement strategy. First, there is evidence for a summation strategy - resolved (dual) agreement is the most common response after two singular conjuncts, and plural agreement is found around a quarter of the time after mixed conjuncts. However, there is also evidence of single-conjunct agreement - singular agreement was found after two singular conjuncts and after mixed conjuncts.

I first consider the implications for agreement strategies in Slovene. Dual agreement was higher than any other agreement in the singular-singular condition, which would be compatible with a summation strategy. However, the incidence

of the dual was highest in the dual-dual condition, showing that summing number values was not the only strategy used. In fact, fewer plural forms were found in the dual-dual condition than in the singular-dual and dual-singular, suggesting that although summing number values was used, repetition of one of the coordinands' number was more common (summing would have resulted in plural outcomes for all conditions except singular-singular), and also that mixed coordinands resulted in the summation strategy being used more than with coordinands of the same number value. Singular agreement was high in the singular-singular condition, likewise suggesting repetition of the coordinands' number value. Surprisingly, resolution (summation) was found to be a more popular strategy in the mismatch conditions than in the dual match condition, suggesting that mismatch of number in coordinands leads to more single-conjunct agreement when one coordinand is not singular (the highest rate of responses consistent with the summation strategy came in the sing-sing condition).

Linear word order was found to affect agreement with disjunctive NPs. Although theoretically linear word order might influence resolved agreement, this was not found to be the case. There was no difference between the rates of plural (resolved) agreement in mixed number conjuncts.

There was numerically more dual agreement directly following a dual coordinand than a singular when the coordinands were of mixed number, but this effect was not statistically reliable (probably due to the production of plural responses instead of dual responses in these conditions).

Most importantly, there is evidence of an effect of linear word order on agreement. There was significantly more singular agreement directly following a singular conjunct than following a dual conjunct when the conjuncts were of mixed number. Furthermore, there was a numerical (but not statistically significant) trend towards more dual and plural agreement after singular-dual than after dual-singular. This suggests that of the two possible partial agreement strategies, nearest- and not furthest-conjunct agreement is preferred (contra Corbett, 1991). Word order effects on number agreement are inconsistent with an approach which takes account of syntactic information only; linear word order is clearly crucial in deciding whether a target agrees with one or conjunct or another.

Condition	Sentence preamble	
sing-sing	Vojak in mornar	Soldier and sailor
plural-sing	Vojaki in mornar	Soldiers and sailor
sing-plural	Vojak in mornarji	Soldier and sailors
plural-plural	Vojaki in mornarji	Soldiers and sailors

Table 5.4: Experiment 7 materials

## 5.4 Experiment 7: Slovene conjuncts agreement - plural versus singular

Experiment 6 demonstrated that people do actually produce single-conjunct agreement as has been claimed, but that the agreement tends to be not with the furthest coordinand (Corbett, 1983) but with the nearest coordinand (Bajec et al., 1956). Although the majority of the single-conjunct agreement found in both mixed and same number conjunct conditions was dual, it also accounted for over 40% of the responses even when both conjuncts were singular. Thus it is interesting to investigate whether single-conjunct agreement may be found even when one of the coordinands is plural. According to Bajec et al. (1956), “when *one of the conjuncts is in the plural*, plural must be the outcome” [my translation; my italics], thus we would expect less effect of position in this experiment than in the last experiment.

Importantly, this experiment sought to confirm whether linear order can affect agreement. Experiment 7 investigated whether the first conjunct, second conjunct or the sum of the two is used in the production of agreement, but this time using singular and plural number values only.

Furthermore, Experiment 7 tested whether or not single-conjunct agreement is possible with a conjunction like *in* ‘and’ instead of the disjunctive *ali* ‘or’. Previous psycholinguistic studies of agreement in coordination which have found an effect of linear proximity have been restricted to disjunctive coordinators (‘or’) (Haskell and MacDonald, 2005; Hemforth and Konieczny, 2003); Timmermans et al. (2004) failed to find effects of linear proximity using ‘and’.

### 5.4.1 Predictions

If linear word order affects agreement then we would expect some agreement with only one of the coordinands as opposed to the sum of both coordinands (contra Bajec et al., 1956). If there is an effect of linear order, this extends the

findings from merely disjunctive coordination (Hemforth and Konieczny, 2003; Haskell and MacDonald, 2005) to conjunctive coordination, providing more evidence for a model of agreement processing which has access to later processes like word order as well as the functional level.

Following the results in Experiment 6, we would expect that the second conjunct (nearest) conjunct would be more important than the first (furthest), such that there would be an effect of second conjunct and participants would be more likely to produce a predicate agreeing in number with the second conjunct than with the first. This would provide empirical data which would elucidate the debate about furthest-conjunct agreement in Slovene. If linear order can affect agreement, then we would expect to find that in at least some cases, participants will produce agreement with only one of the conjuncts as opposed to the sum of both conjuncts, and the agreement number will be dependent on the order (as in Example 251).

- (251) vojaki in mornar je odšel  
 soldier.PL and sailor.SG AUX.SG leave.PPL  
 ‘Some soldiers or the sailor left’

This would suggest that agreement does not happen before word order is computed (Vigliocco and Nicol, 1998) or that word order information is available during agreement computation as well as after it.

Following Haskell and MacDonald (2005), we would expect that the second (nearest) coordinand is more important than the first (furthest) coordinand, such that there will be an effect of second coordinand and participants will be more likely to produce a predicate agreeing in number with the second coordinand than with the first. This would manifest itself as an effect of second coordinand. Alternatively, if any agreement except resolved agreement is with the first (furthest) coordinand, this would support the accounts of Corbett (1986) and Johannessen (1998). Since Slovene is also head-initial, this means that “the non-agreeing conjunct will be in the same position relative to the conjunction as other complements are to their heads”, thus only first conjunct agreement and not second conjunct agreement is possible with SV word order. If there is both nearest- and furthest-conjunct agreement, then the effects may cancel each other out. Thus a null result would either mean different types of single-conjunct agreement, or a lack of linear word order effects.

More specifically, if linear order affects word order, then if agreement is with the nearest conjunct, there would be more plural agreement after a subject like ‘a soldier and some sailors’ compared to both ‘a soldier and a sailor’ and ‘some soldiers and a sailor’. Similarly, there would be more singular agreement after a subject like ‘some soldiers and a sailor’ than after either ‘some soldiers and some sailors’ or ‘a soldier and some sailors’. Alternatively, if agreement is with the furthest conjunct, then we would expect more dual agreement after a subject like ‘some soldiers and a sailor’ than after either ‘some soldiers and some sailors’ or ‘a soldier and some sailors’ and more singular agreement after a subject like ‘a soldier and some sailors’ compared to both ‘a soldier and a sailor’ and ‘some soldiers and a sailor’. If linear order also affects random agreement errors, then we would expect the two mixed conjuncts (e.g., ‘a soldier and some sailors’ and ‘some soldiers and a sailor’) to differ as to rates of dual agreement.

#### 5.4.2 Method

##### *Procedure*

The procedure was as in Experiment 6 except for one detail. In order to increase the amount of complete gender and number marking on the completions, the instructions differed slightly from those used in Experiment 6, in that instead of being encouraged to complete the sentence using a verb, the participants were encouraged to complete the sentence using an adjective<sup>4</sup>). This change was not expected to affect the outcome, since it was found by Antón-Méndez et al. (2002) the agreement process was unitary whether agreement was with an adjective or a verb.. Examples and practice materials were changed accordingly, e.g.,

(252) jagode            in   maline            so            bile            dobre  
           strawberry.PL and raspberry.PL AUX.PL be.PAST.PL good.PL  
           ‘The strawberries and the raspberries were good’

Their participants completed sentences containing a head noun (always singular; masculine or feminine) and a local noun (which varied as to whether it was singular or plural, but matched in gender with the head noun). Hence my results should be comparable with those presented in Experiment 6.

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<sup>4</sup>Note that many other experiments have employed an adjective as a completion word, for example Barker et al., 2001; Haskell & MacDonald, 2005; Vigliocco & Nicol, 1998.

### *Materials*

Singular and plural conjuncts were employed. The 32 experimental items crossed number (singular or plural) with position (first or second). Gender remained constant within items but varied across items, with half masculine and half feminine. Fillers consisted of conjuncts (masculine or feminine). All stimuli, fillers and experimental items, used the conjunctive coordinator *in* 'and'. Examples of materials are shown in Table 5.4 and in Appendix G.

### *Participants*

There were 40 participants, drawn from the same pool as in Experiment 7. 15 were male and 25 female.

#### *5.4.3 Design and data analysis*

The major statistical tests were performed using the agreement produced in each gender as the dependent variable. Two analyses of variance were carried out, one with participants and one with experimental items as random factor. All effects that are reported as significant achieved significance at the .05 level or beyond. Planned pairwise comparisons were used to evaluate predicted differences between conditions, using the mean-square error of the relevant interactions from the participants and items analyses separately.

#### *5.4.4 Results*

There were 1280 responses. I excluded 10 responses which were inaudible. I excluded one participant (32 responses) who had only attempted two items. I analysed the remaining 1238 as in Experiment 1. Of these, 1091 involved a response with agreement marking. These 1091 were analysed as proportions of all agreement marked responses produced in that condition. No cells were replaced.

The percentages are shown in Table 5.6. The responses including agreement are shown for each of the four conditions, where the first conjunct is singular and the second also singular (sing-sing), the first conjunct is singular and the second plural (sing-plur), the first conjunct is plural and the second singular (plur-sing), and where both conjuncts are plural (plur-plur).

Response	Conjunct number (first conjunct-second conjunct)			
	sing-sing	sing-plur	plur-sing	plur-plur
sing	1	0	1	0
dual	265	5	42	5
plural	9	266	222	275

Table 5.5: Experiment 7 - raw responses of all agreement produced with 'and'

showing agreement for singular first conjuncts with singular and plural second conjuncts, and plural first conjuncts with singular and plural second conjuncts

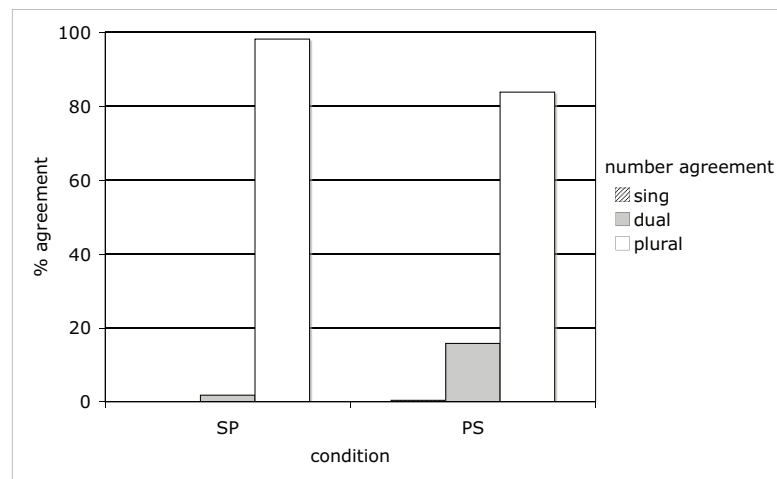


Figure 5.2: Experiment 7 - all agreement produced for mixed (sing-plur and plur-sing) conjuncts

### *Singular agreement*

There were no main effects of first conjunct number (all  $F$ s  $< 1$ ) or second conjunct number ( $F_1(1, 38) = 2.11, p > .1$ ;  $F_2(1, 31) = 2.06, p > .1$ ). There was no interaction between first and second conjunct number (all  $F$ s  $< 1$ ): participants were extremely unlikely to produce singular responses, and only did so twice. There was no difference between the two mismatch conditions (all  $F$ s  $\geq 1$ ).

### *Dual agreement*

There was a main effect of first conjunct number ( $F_1(1, 38) = 614.61, p < .001$ ;  $F_2(1, 31) = 619.65, p < .001$ ), with more dual agreement after a singular than a plural first conjunct; there was also a main effect of second conjunct number ( $F_1(1, 38) = 1309.63, p < .001$ ;  $F_2(1, 31) = 1553.69, p < .001$ ), with more dual agreement after a singular than a plural second conjunct. There was an interaction between first and second conjunct number ( $F_1(1, 38) = 523.73, p < .001$ ;  $F_2(1, 31) = 560.40,$

Response	Conjunct number (first conjunct-second conjunct)			
	sing-sing	sing-plur	plur-sing	plur-plur
sing	0.4	0	0.4	0
dual	96.4	1.8	15.8	1.8
plural	3.3	98.2	83.8	88.2

Table 5.6: Experiment 7 - percentages of all agreement produced with 'and'

$p < .001$ ): participants were more likely to produce dual responses following a plural second conjunct than following a singular second conjunct when the first conjunct was also singular than when it was plural (sing-sing minus sing-plur = 94.6% versus plur-sing minus plur-plur = 14.0% difference).

Importantly, as can be seen in Figure 5.2, in the mixed conjuncts conditions, there was significantly more (14.0%) dual agreement directly following the singular conjunct (15.8%) compared to directly following the plural conjunct (1.8%) ( $F_1(1, 38) = 30.87, p < .001$ ;  $F_2(1, 31) = 31.28, p < .001$ ).

#### *Plural agreement*

There was a main effect of first conjunct number ( $F_1(1, 38) = 614.08, p < .001$ ;  $F_2(1, 31) = 592.74, p < .001$ ), with more plural agreement after a plural than a singular first conjunct; there was also a main effect of second conjunct number ( $F_1(1, 38) = 1401.25, p < .001$ ;  $F_2(1, 31) = 1682.38, p < .001$ ), with more plural responses after a plural than a singular second conjunct. Critically, there was an interaction between first and second conjunct number ( $F_1(1, 38) = 510.47, p < .001$ ;  $F_2(1, 14) = 37.61, p < .001$ ): participants were more likely to produce plural responses following a plural second conjunct than following a singular second conjunct when the first conjunct was a singular (95.1%) than when it was plural (4.4%) (sing-plur minus sing-sing versus plur-plur minus plur-sing).

Importantly, in the mixed conjuncts conditions, there was significantly more (14.4%) plural agreement directly following the plural conjunct (98.2%) compared to directly following the singular conjunct (83.8%) ( $F_1(1, 38) = 32.83, p < .001$ ;  $F_2(1, 31) = 32.93, p < .001$ ).

#### 5.4.5 Discussion

Evidence of more than one agreement strategy was found. Resolved agreement was most common.

Plural agreement was common in all of the items containing a plural conjunct, but the results suggest that, despite claims to the contrary (Bajec et al., 1956), both conjuncts are necessary in order to control plural agreement and resolved agreement is not automatic. The rate of plural agreement is actually slightly lower in the mismatch conditions than in the match condition, suggesting that nearest-conjunct is not a sufficient condition for plural agreement: if the nearest conjunct were the only element influencing agreement, then we would expect to find plural agreement after a plural conjunct in the match condition too - clearly the match status and / or first conjunct is also playing a role. Dual agreement was higher than any other agreement in the singular-singular condition, which would be compatible with a summation strategy, and, as predicted, it is much higher than with the disjunction *ali* 'or'. However, incidence of the dual was higher than would be expected in the plural-singular condition, suggesting misanalysis of the first conjunct, or else due to the increase in working memory required to keep the two number values in memory (after singular-plural, no such effort is required, as there is no difference between resolved and nearest-conjunct agreement).

This experiment set out to test whether or not there is an effect of linear word order on agreement. It was found that the order of the conjuncts did have an effect on the rate of single-conjunct agreement with the conjunction *ali* 'or', even using plural conjuncts (contra Bajec et al., 1956). Slovene conjuncts were found to induce nearest-, not furthest-conjunct agreement. There was significantly more plural agreement directly following a plural conjunct than directly following a singular conjunct. Singular completion was only produced after a singular second conjunct and not elsewhere, but it was too rare to be analysed. There was also more dual agreement directly following a singular conjunct than directly following a plural conjunct. Crucially, strong effects of linear word order were found, showing that agreement production is affected by later processes. This adds to the evidence in favour of linear order effects found in Experiments 6 and 7, and provides more evidence that agreement processing does not only take account of syntactic information. This is consistent with a one-stage model of production (Pickering et al., 2001a).

## 5.5 Coordinating Gender Agreement

The choice of nearest-conjunct agreement or resolved agreement is available in gender as in number, but it is clear that agreement cannot be resolved in the same

way in the former as in the latter. Although nearest-conjunct agreement makes sense for both, the (arguably more common) summation strategy cannot work to resolve gender mismatches; singular plus singular is clearly dual but what is feminine plus neuter?

Different languages display different answers to this question: in French, mixed conjuncts always resolve agreement to the masculine gender, but this is not true cross-linguistically, since (as we saw above in Example 237) in some languages with three genders such as Icelandic, any mixed agreement (including masculine and feminine) is resolved to neuter.

With respect to Slovene, it is claimed that mixed gender conjuncts tend to be resolved to masculine agreement (Corbett, 1991; Bajec et al., 1956). Neuter plus feminine, or masculine plus feminine, both resolve to masculine. We might suggest that instead of resolution, what we have here is a strongest (most marked?) wins out, but actually, that is not true either, since neuter plus neuter is also claimed to result in masculine (Corbett, 1991; Bajec et al., 1956).

So is the masculine the default? As discussed in Chapter 4, it is not clear if languages have a default gender (although c.f. Vigliocco and Franck, 2001), and if they do, which is the default gender for Slovene.

Of course, resolving gender is only one option. Another option is to use nearest-conjunct agreement. The following experiments seek to investigate to what extent resolved and nearest-conjunct agreement are used in gender agreement with coordinators in Slovene and how gender is resolved. As in Experiments 6 and 7, the results will be informative about the extent to which linear order affects agreement. In particular, they will allow us to investigate whether linear order effects generalise from number to a different type of agreement, gender.

## 5.6 Experiment 8: Slovene conjuncts agreement - masculine versus feminine

Linguistic theory and Slovene grammars both make reference to single-conjunct agreement. Experiment 8 tests whether this phenomenon is found in gender agreement, and if so, whether agreement is with the furthest or nearest co-ordinand.

The current experiment will again test whether linear agreement affects agreement, using the coordinator *in* 'and' but replacing singular and plural number with masculine and feminine gender. Previous work has examined feminine and masculine gender agreement in a bipartite system. It will be informative to examine the same two genders but in a tripartite system, thus the results can be compared to those of previous studies (Meyer and Bock, 1999). Although there has been little previous work done on gender agreement with conjoined noun phrases until now, in order to allow future comparison with experiments carried out in more languages, and also to facilitate comparison with research carried out on gender agreement with other types of NPs, the masculine and feminine gender were chosen. Additionally, as discussed above, since it is expected that two neuter conjuncts would be resolved to masculine agreement whereas two feminine conjuncts would be resolved to feminine agreement, this allows a more straightforward comparison between the responses.

### 5.6.1 Predictions

If linear word order affects agreement, then we would expect to find that in at least some cases, participants will produce agreement with only one of the conjuncts, and the gender agreement will be dependent on the linear order of the conjuncts. If agreement is with the nearest conjunct, then we would expect that there would be more feminine agreement after a subject like 'a boy and his female cousin' compared to both 'a boy and his male cousin' and 'a girl and her male cousin'. Similarly, there would be more masculine agreement after a subject like 'a girl and her male cousin' than after either 'a girl and her female cousin' or 'a boy and his female cousin'. Alternatively, if agreement is with the furthest conjunct, then we would expect the opposite pattern of results. If agreement affects random (neuter) agreement, then we would expect a difference in the rate of neuter agreement between the mismatch conditions.

### 5.6.2 Method

#### *Procedure*

The procedure was as in Experiment 7.

Condition	Sentence preamble	
masc-masc	Deček in bratranec	Boy and male cousin
masc-fem	Deček in sestrična	Boy and female cousin
fem-masc	Punca in bratranec	Girl and male cousin
fem-fem	Punca in sestrična	Girl and female cousin

Table 5.7: Experiment 8 materials

### *Materials*

There were 32 experimental items. Masculine and feminine conjuncts were employed. The 32 experimental items crossed gender of first conjunct (masculine or feminine) with gender of second conjunct (masculine or feminine). Possible completions were thus masculine (resolved agreement or agreement with one of the conjuncts only), feminine (agreement with one of the conjuncts only) or neuter (agreement with neither of the conjuncts). Number remained constant within items (it was always singular). Examples of materials are shown in Table 5.7 and in Appendix H.

There were also 32 filler items, consisting of other conjuncts (singular or plural), half of which were masculine and half feminine. Additionally the phrase discussed above, *Groza in strah*, was added at the end of the randomised set of items to see whether it would induce furthest-conjunct agreement under laboratory conditions.

### *Participants*

There were 40 participants, drawn from the same pool as in the previous experiments. 16 were male and 24 female.

#### 5.6.3 *Design and data analysis*

The major statistical tests were performed using the agreement produced in each gender as the dependent variable. 2 (first position gender) by 2 (second position gender) analyses of variance were carried out. Two analyses of variance were carried out, one with participants and one with experimental items as random factor. All effects that are reported as significant achieved significance at the .05 level or beyond. Errors are reported as proportions of all agreement to facilitate comparison between experiments. Planned pairwise comparisons were used to

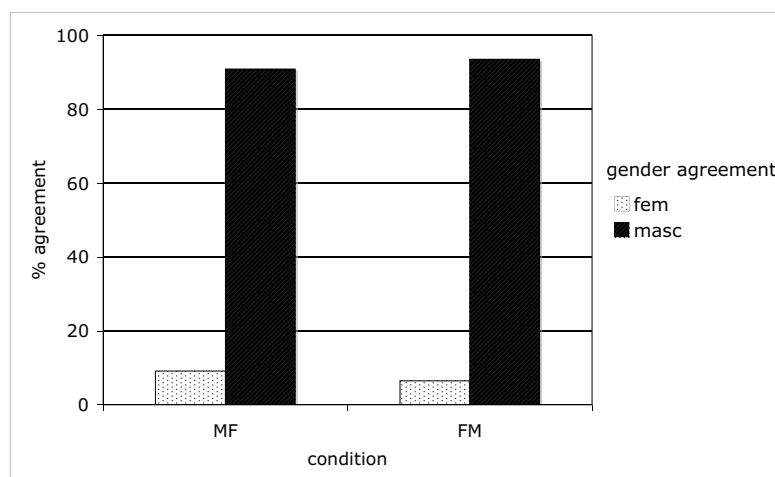


Figure 5.3: Experiment 8 - all agreement produced for mixed (masc-fem and fem-masc) conjuncts

showing agreement for masculine first conjuncts with masculine and feminine second conjuncts, and feminine first conjuncts with masculine and feminine second conjuncts

evaluate predicted differences between conditions, using the mean-square error of the relevant interactions from the participants and items analyses separately.

#### 5.6.4 Results

There were 1280 responses. I excluded 6 responses that were inaudible. I excluded one participant (32 responses) who had only attempted two items. I analysed the remaining 1242 as in Experiment 1. Of these, 779 involved a response with gender agreement marking. These were analysed as proportions of all gender agreement marked responses produced in that condition. As in Experiment 6, where no response with gender agreement marking was produced in a particular condition (for a participant or for an item), the missing proportion was replaced with the mean of that participant / item in that condition. Fifteen cells were replaced in the participants file and none in the items file. There was no neuter agreement, thus the masculine and feminine analyses are complementary. The choice to report the analysis on the feminine agreement (below) is therefore arbitrary.

The percentages are shown in Table 5.9. The responses including agreement are shown for each of the four conditions: where the first conjunct is masculine and the second also masculine (MM); the first conjunct is masculine and the second

Response	Conjunct gender (first conjunct, second conjunct)			
	MM	MF	FM	FF
fem	11	18	12	175
masc	189	180	173	21

Table 5.8: Experiment 8 - raw responses of all agreement produced with 'and'

Response	Conjunct gender (first conjunct, second conjunct)			
	MM	MF	FM	FF
fem	5.5	9.1	6.5	89.3
masc	94.5	90.9	93.5	10.7

Table 5.9: Experiment 8 - percentages of all agreement produced with 'and'

feminine (MF); the first conjunct is feminine and the second masculine (FM); and where both conjuncts are feminine (FF).

#### *Feminine agreement*

There were main effects of first conjunct gender ( $F_1(1, 38) = 363.77, p < .001$ ;  $F_2(1, 31) = 361.29, p < .001$ ), with more feminine responses after a feminine than a masculine first conjunct, and second conjunct gender ( $F_1(1, 38) = 332.57, p < .001$ ;  $F_2(1, 31) = 339.21, p < .001$ ), with more feminine responses after a feminine than a masculine second conjunct. There was an interaction between first and second conjunct gender ( $F_1(1, 38) = 343.23, p < .001$ ;  $F_2(1, 31) = 385.10, p < .001$ ): participants were more likely to produce feminine responses following a feminine second conjunct than following a masculine second conjunct when the first conjunct was feminine than when it was masculine (FF minus FM = 82.8% versus MF minus MM = 3.6% difference). As can be seen in Figure 5.3, there was a tendency towards a difference between the number of feminine responses produced after mixed conjuncts depending on their order (MF minus FM = 2.6%) but this was marginal by participants only ( $F_1(1, 38) = 3.65, p = .064$ ;  $F_2(1, 31) = 1.02, p > .1$ )

The additional item *groza in strah* induced only twenty-three instances of gendered agreement. Of these, twenty-two were masculine and one was neuter singular.

### 5.6.5 Discussion

This experiment set out to examine what determines gender agreement following conjoined NPs in Slovene and to test whether or not there is an effect of linear word order on agreement.

First, and most basically, Experiment 8 provided evidence that the gender of the coordinands did have an effect on the rate of single-conjunct agreement when coordinands were masculine and feminine and included a disjunction (*in* 'and'). Specifically, participants were particularly likely to produce feminine agreement when both coordinands were feminine, and masculine agreement when one of the coordinands was masculine. Feminine agreement was produced rarely when one of the coordinands was masculine; this was most common directly following a feminine conjunct. Neuter agreement was not produced.

Experiment 8 provides evidence for more than one agreement strategy. First, there is evidence for a resolved strategy - resolved (masculine) agreement is the most common response after two masculine conjuncts, and also after mixed conjuncts. However, there is also evidence of single-conjunct agreement - feminine agreement was found after two mixed gender conjuncts as well as after feminine conjuncts.

I first consider the implications for agreement strategies in Slovene. Masculine agreement was higher than any other agreement in the mixed conjunct conditions, which would be compatible with a resolved strategy. However, the incidence of the masculine was higher in the feminine-masculine condition than in the masculine-feminine condition, suggesting that although resolution may have been used, repetition of one of the coordinands' number was also occurring. As in Experiment 7, there was little difference between the rates of the most common (masculine / plural) type of agreement produced in three of the conditions (i.e. excepting the feminine-only and singular-only conditions).

Linear word order was found to affect gender agreement with conjoined NPs.

Although theoretically linear word order might influence resolved agreement, it is not possible to measure resolved agreement separately from single-conjunct agreement, since one of the conjuncts (masculine) is the same as the resolved form.

When the coordinands were of mixed gender, there was numerically more feminine agreement directly following a feminine coordinand than a masculine and, conversely, more masculine agreement directly following a masculine coordinand than a feminine, but this effect was not statistically reliable (probably due to sparse data).

This suggests that of the two possible partial agreement strategies, nearest- and not furthest-conjunct agreement is preferred (contra Corbett, 1991). This also suggests that Johannessen's (1998) claim that agreement is with the first coordinand if the language is head-initial is not accurate. If word order affects gender agreement, this is inconsistent with an approach which only takes account of syntactic information; linear word order may be implicated in deciding whether a target agrees with one or another coordinand in gender.

It was found that the gender of the conjuncts did have an effect on the rate of production of masculine and feminine gender agreement; there were more feminine responses directly following a feminine conjunct compared to when the feminine conjunct was separated from the verb by a masculine conjunct (and likewise with masculine responses following a masculine conjunct). The feminine agreement following a mixed or masculine preamble may be assumed to be single-conjunct agreement.

Overall, masculine agreement was by far the most common response type. The rates of agreement of the most dominant response type were similar to in Experiment 7 which also used the conjunction 'and'. It may be assumed that the resolution strategy is used with the conjunction 'and', and that is the most common strategy, but, as with the plural agreement in the last experiment (and other number agreement experiments in the literature), it is impossible to distinguish masculine resolved agreement from masculine nearest-conjunct agreement.

To determine the gender agreement of the verb when there is a conjoined subject, the gender of both first and second conjunct is significant. However, the results were clearly driven by one condition, hence the lack of interaction. Feminine agreement was produced when both conjuncts were feminine, and rarely elsewhere. It was found that the order of the conjuncts did not have a significant effect on the rate of single-conjunct gender agreement, although there was a slight tendency for more feminine responses directly following a feminine conjunct compared to when the feminine conjunct was separated from the verb by a

masculine conjunct (and likewise with masculine responses following a masculine conjunct).

Interestingly, even the conjunct *groza in strah* 'horror and fear' failed to induce single-conjunct agreement, resulting in only resolved masculine agreement and neuter singular agreement. There was thus no support found for the notion of furthest-conjunct agreement even with this collocated phrase.

There were too few instances of neuter agreement to see any pattern. It would be interesting to explore the production of neuter agreement after neuter conjuncts.

The results showed a trend towards an effect of linear order (i.e. there was more masculine agreement with feminine-masculine conjunct order than with masculine-feminine conjunct order, and more feminine agreement with masculine-feminine conjunct order than with feminine-masculine conjunct order). Since following the results of Experiments 6 and 7, it may be assumed that the resolution strategy is used with the conjunction 'and' more often than the disjunction 'or', the next experiment therefore goes on to test whether a linear effect may, as in English, be more common when the coordinator is disjunctive.

In summary, Experiment 8 showed that by far the most popular response after mixed conjuncts was masculine, suggesting that resolved agreement is the most popular strategy. Single-conjunct agreement was found too, however. The results showed that there was more masculine agreement after a masculine conjunct and more feminine agreement after a feminine conjunct, showing that, in gender agreement processing as well as in number agreement processing, both conjuncts are important during agreement production. There was a non-significant trend towards an effect of linear word order.

### 5.7 Experiment 9: The coordinator - *in* 'and' versus *ali* 'or'

Experiment 9 was designed to provide more evidence that in single conjunct agreement, it is the second conjunct or resolved agreement that is used in the production of gender agreement.

Since Experiments 6-8 were equivocal as to the amount of single-conjunct agreement found and the conditions under which it was found, Experiment 9 replicates Experiment 8 and furthermore explicitly manipulated the coordinator, *in* 'and' or *ali* 'or'. Both are coordinating conjunctions, which link constituents

without syntactically subordinating one to the other. However, whilst conjunctions depend on both conjuncts being true for a statement to be true, disjunctions depend on one (or both, if the disjunction is inclusive) of the conjuncts being true for a statement to be true, which suggests more logical complexity. Whilst conjunctions are expected to result in resolved agreement, disjunctions are associated with single-conjunct agreement, presumably because since both coordinands are not necessarily necessary, agreement with one of them is more acceptable.

Having seen that semantics affects agreement (in Chapter 3), we might expect that the differences between coordinators ('and' and 'or') would also have an influence on the agreement produced after a coordinated noun phrase.

If coordinator interacts with conjunct gender, then this would show that order effects are not globally consistent, but may interact with meaning.

### 5.7.1 Predictions

Experiment 8 suggested a trend towards single-conjunct agreement with the nearest coordinand, thus it is expected that Experiment 9 will also show more responses with matching than mismatching gender after a particular gendered coordinand.

Since there was strong single-coordinand agreement after 'or' (Experiment 6) and weaker effects found with 'and' (Experiment 8; although Experiment 7 also showed a strong single-conjunct agreement after 'and'), it is also predicted that there will be more single-conjunct agreement after 'or' than after 'and'.

If linear word order affects gender agreement (as it is shown decisively to affect number agreement in Experiments 6 and 7), then we can expect more agreement with the second coordinand than the first coordinand in mismatch conditions. Specifically, we would expect to find that in at least some cases, participants will produce agreement with only one of the coordinands, and the gender agreement will be dependent on the order. If agreement is with the nearest coordinand, then we would expect that there would be more feminine agreement after a subject like 'a boy and his female cousin' compared to both 'a boy and his male cousin' and 'a girl and her male cousin'. Similarly, there would be more masculine agreement after a subject like 'a girl and her male cousin' than after either 'a girl and her female cousin' or 'a boy and his female cousin'. Alternatively, if agreement

Response	Sentence preamble	
&-masc-masc	Deček in bratranec	Boy and male cousin
&-masc-fem	Deček in sestrična	Boy and female cousin
&-fem-masc	Punca in bratranec	Girl and male cousin
&-fem-fem	Punca in sestrična	Girl and female cousin
/-masc-masc	Deček ali bratranec	Boy or male cousin
/-masc-fem	Deček ali sestrična	Boy or female cousin
/-fem-masc	Punca ali bratranec	Girl or male cousin
/-fem-fem	Punca ali sestrična	Girl or female cousin

Table 5.10: Experiment 9 materials

is with the furthest coordinand, then we would expect the opposite pattern of results. If coordinator interacts with linear order, then we would expect more agreement with the nearest (or else furthest) coordinand after the disjunction *ali* ‘or’ and less after the conjunction *in* ‘and’.

### 5.7.2 Method

#### *Procedure*

The procedure was identical to Experiment 6.

#### *Materials*

There were 32 experimental items. Masculine and feminine coordinands were employed. The materials were adapted from those used in Experiment 8. The items crossed gender of first coordinand (masculine or feminine) with gender of second coordinand (masculine or feminine). Number remained constant within items (it was always singular). In addition, the coordinator was also crossed, with *in* ‘and’ or *ali* ‘or’ being employed. Examples of the materials are shown in Table 5.10 and Appendix I.

There were also 32 filler items, consisting of other coordinands (singular or dual), half of which were masculine and half feminine, plus the famous phrase *Groza in strah* was added at the end to test whether this famous phrase, well known for its capacity to induce furthest-conjunct agreement, would do so under laboratory conditions.

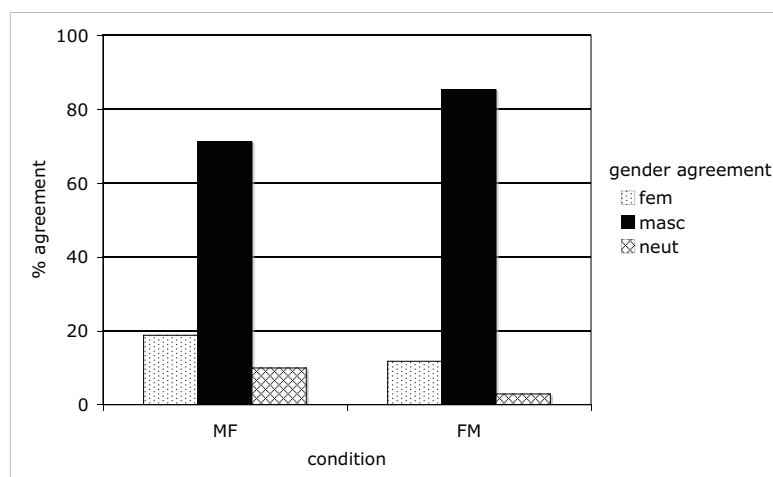


Figure 5.4: Experiment 9 - all agreement produced for mixed (masc-fem and fem-masc) conjuncts (collapsed over coordinator)

showing agreement for masculine first conjuncts with masculine and feminine second conjuncts, and feminine first conjuncts with masculine and feminine second conjuncts

### 5.7.3 Participants

There were 72 participants, all students at Ljubljana University, drawn from the same pool as the other experiments.

### 5.7.4 Design and data analysis

The major statistical tests were performed using the agreement produced in each gender as the dependent variable. 2 (coordinator) by 2 (first position gender) by 2 (second position gender) analyses of variance were carried out. Two analyses of variance were carried out, one with participants and one with experimental items as random factor. All effects that are reported as significant achieved significance at the .05 level or beyond. Planned pairwise comparisons were used to evaluate predicted differences between conditions, using the mean-square error of the relevant interactions from the participants and items analyses separately.

### 5.7.5 Results

#### *Overall analyses (collapsed over coordinator)*

I will first present the overall results, before turning my attention to difference between the two coordinators. Results for the two coordinators are therefore collapsed here (see Table 5.12).

Response	Conjunct gender (first conjunct, second conjunct)			
	MM	MF	FM	FF
fem	14	28	16	124
masc	115	106	116	25
neut	10	15	4	7

Table 5.11: Experiment 9 - raw responses of all gender agreement produced (collapsed over coordinator)

### *Details*

There were 2304 responses. I excluded 22 responses that were inaudible. I excluded one participant (32 responses) who had only attempted three items. I analysed the remaining 2250 as in Experiments 6-8. Of these, 1162 involved a response with number but no gender marking and 508 did not involve correct agreement after a correctly repeated preamble, leaving a total of 580 responses with gender agreement marking. These 580 responses were analysed as proportions of all gender agreement marked responses produced in that condition. Where no response with gender agreement marking was produced in a particular condition (for a participant or for an item), the missing proportion was replaced with the mean of that participant or item in that condition. In the general analysis (collapsed over coordinator), 201 cells were replaced in the participants analysis and 6 in the items analysis. In the fine-grained analysis comparing the two different types of coordinands, 1017 cells were replaced in the participants file and 81 in the items file.

The raw response data are shown in Table 5.11. The responses including agreement are shown for each of the four conditions: where the first coordinand is masculine and the second also masculine (MM); the first coordinand is masculine and the second feminine (MF); the first coordinand is feminine and the second masculine (FM); and where both coordinands are feminine (FF).

### *Masculine agreement*

There were main effects of first coordinand gender ( $F_1(1, 70) = 39.25, p < .001$ ;  $F_2(1, 31) = 48.09, p < .001$ ), with more masculine responses after a masculine than a feminine first coordinand; and of second coordinand gender ( $F_1(1, 70) = 138.10, p < .001$ ;  $F_2(1, 31) = 132.34, p < .001$ ), with more masculine responses after a masculine than a feminine second coordinand. There was an interaction

between first and second coordinand gender ( $F_1(1, 70) = 112.67, p < .001$ ;  $F_2(1, 31) = 35.92, p < .001$ ): participants were more likely to produce masculine responses following a masculine second coordinand than following a feminine second coordinand when the first coordinand was also feminine than when it was masculine (FM minus FF = 69.3% versus MM minus MF = 11.5% difference). There was an effect of linear ordering of mixed coordinands (shown in Figure 5.4, with more masculine agreement directly following a masculine coordinand than directly following a feminine coordinand ( $F_1(1, 70) = 16.12, p < .001$ ;  $F_2(1, 31) = 4.73, p < .05$ ).

#### *Feminine agreement*

There were main effects of first coordinand gender ( $F_1(1, 70) = 82.98, p < .001$ ;  $F_2(1, 31) = 64.08, p < .001$ ), with more feminine responses after a feminine than a masculine first coordinand; and of second coordinand gender ( $F_1(1, 70) = 146.50, p < .001$ ;  $F_2(1, 31) = 151.77, p < .001$ ), with more feminine responses after a feminine than a masculine second coordinand. There was an interaction between first and second coordinand gender ( $F_1(1, 70) = 129.37, p < .001$ ;  $F_2(1, 31) = 59.67, p < .001$ ): participants were more likely to produce feminine responses following a feminine second coordinand than following a masculine second coordinand when the first coordinand was also feminine than when it was masculine (FF minus FM = 67.7% versus MF minus MM = 8.8% difference). There was an effect of linear ordering of mixed coordinands, with more feminine agreement directly following a feminine coordinand than directly following a masculine coordinand (not significant by items) ( $F_1(1, 70) = 5.36, p < .03$ ;  $F_2(1, 31) < 1$ ).

#### *Neuter agreement*

There were main effects of first coordinand gender ( $F_1(1, 70) = 9.50, p = .003$ ;  $F_2(1, 31) = 5.92, p = .021$ ) but not of second coordinand number ( $F_1(1, 70) < 1$ ;  $F_2(1, 31) = 1.11, p > .1$ ). The numerical tendency towards an interaction between first and second coordinand number did not reach significance ( $F_1(1, 70) = 1.39, p > .1$ ;  $F_2 < 1$ ). There was an effect of linear ordering of mixed coordinands, with more neuter agreement directly following a feminine coordinand than directly following a masculine coordinand (marginal by items) ( $F_1(1, 70) = 11.54, p < .001$ ;  $F_2(1, 31) = 3.71, p = .063$ ).

Response	Conjunct gender (first conjunct, second conjunct)			
	MM	MF	FM	FF
fem	10.0	18.8	11.8	79.5
masc	82.7	71.2	85.3	16.0
neut	7.3	10.0	2.9	4.5

Table 5.12: Experiment 9 - percentages of all gender agreement produced (collapsed over coordinator)

Response	Conjunct gender (first conjunct, second conjunct)							
	in 'and'				ali 'or'			
	MM	MF	FM	FF	MM	MF	FM	FF
fem	6	9	11	69	8	19	5	55
masc	55	69	72	11	60	37	44	14
neut	4	5	0	1	6	10	4	6

Table 5.13: Experiment 9 - raw responses of all gender agreement produced

showing agreement for masculine first conjuncts with masculine and feminine second conjuncts, and feminine first conjuncts with masculine and feminine second conjuncts for both coordinators *in* 'and' and *ali* 'or'

### *Two types of coordinator*

The percentages for the analysis comparing two types of coordinator are shown in Table 5.13 and in Figure 5.5. The responses including agreement are shown for each of the eight conditions: where the first coordinand is masculine and the second also masculine (MM); the first coordinand is masculine and the second feminine (MF); the first coordinand is feminine and the second masculine (FM); and where both coordinands are feminine (FF), for both *in* 'and' and *ali* 'or'.

### *Masculine agreement*

There were main effects of coordinator, marginal by items ( $F_1(1, 70) = 20.13, p < .001$ ;  $F_2(1, 31) = 3.50, p = .071$ ), with more masculine responses after *ali* 'or' than after *in* 'and'; first coordinand gender ( $F_1(1, 70) = 94.44, p < .001$ ;  $F_2(1, 31) = 59.24, p < .001$ ), with more masculine responses after a masculine than a feminine first coordinand; and second coordinand gender ( $F_1(1, 70) = 342.90, p < .001$ ;  $F_2(1, 31) = 178.49, p < .001$ ), with more masculine responses after a masculine than a feminine second coordinand. There was an interaction between first coordinand gender and coordinator ( $F_1(1, 70) = 26.03, p < .001$ ;  $F_2(1, 31) = 9.51, p < .005$ ): participants were more likely to produce masculine responses when the

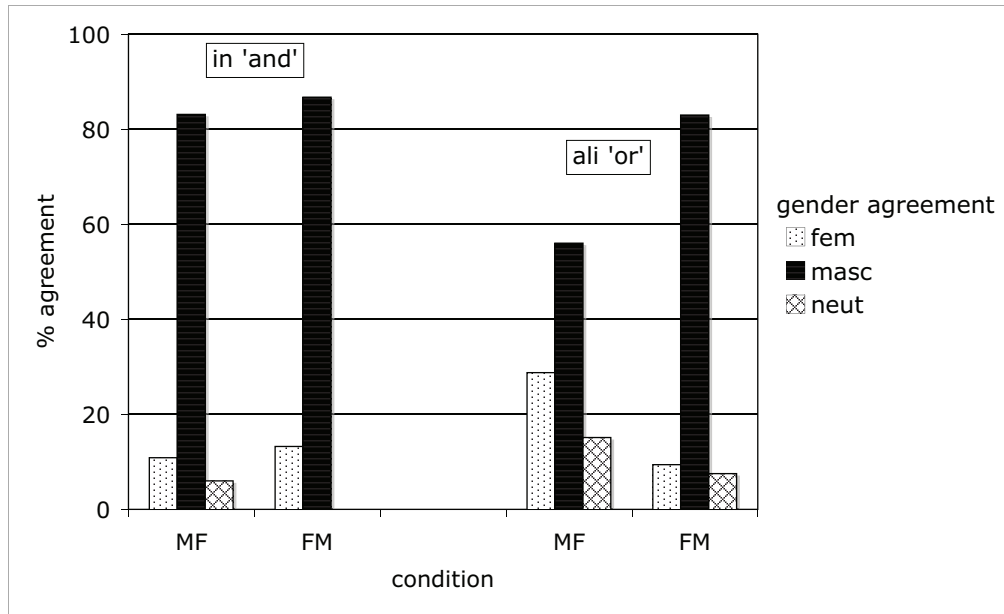


Figure 5.5: Experiment 9 - all agreement produced for mixed (masc-fem and fem-masc) conjuncts - with coordinators *in 'and'* and *ali 'or'*

first coordinand was masculine than when it was feminine after *in 'and'* (17.8% difference) than after *ali 'or'* (33.7% difference); an interaction (marginal by participants) between second coordinand gender and coordinator ( $F_1(1, 70) = 3.47$ ,  $p = .067$ ;  $F_2(1, 31) = 5.92$ ,  $p < .05$ ): participants were more likely to produce masculine responses when the second coordinand was masculine than when it was feminine after *in 'and'* (37.3% difference) than after *ali 'or'* (44.7% difference). The agreement after mixed conjuncts is shown in Figure 5.5.

There was an interaction between first and second coordinand gender ( $F_1(1, 70) = 186.51$ ,  $p < .001$ ;  $F_2(1, 31) = 57.01$ ,  $p < .001$ ): participants were more likely to produce masculine responses following a masculine second coordinand than following a feminine second coordinand when the first coordinand was also feminine (67.7% difference) than when it was masculine (11.5% difference). There was no difference between masculine responses in the mixed coordinand conditions after *in 'and'* ( $F_1(1, 70) = 1.52$ ,  $p > .1$ ;  $F_2 < 1$ ) but after *ali 'or'*, there was a significant difference ( $F_1(1, 70) = 46.16$ ,  $p < .001$ ;  $F_2(1, 31) = 13.97$ ,  $p = .001$ ).

Critically, there was a three-way interaction between coordinator, first coordinand and second coordinand ( $F_1(1, 70) = 19.13$ ,  $p < .001$ ;  $F_2(1, 31) = 6.83$ ,  $p < .02$ ): participants were more likely to produce masculine responses following a masculine second coordinand than following a feminine second coordinand

when the first coordinand was also feminine than when it was masculine, and this effect was significantly stronger after the coordinator *ali* 'or' (73.1% versus 1.5% difference) than after *in* 'and' (64.3% versus 25.0% difference).

#### *Feminine agreement*

There was no main effect of coordinator (all  $F$ s < 1), but there was a main effect of first coordinand gender ( $F_1(1, 70) = 163.29, p < .001$ ;  $F_2(1, 31) = 83.04, p < .001$ ), with more feminine responses after a feminine than a masculine first coordinand, and a main effect of second coordinand gender ( $F_1(1, 70) = 359.15, p < .001$ ;  $F_2(1, 31) = 175.96, p < .001$ ), with more feminine responses after a feminine than a masculine second coordinand. There was an interaction between first coordinand gender and coordinator ( $F_1(1, 70) = 29.14, p < .001$ ;  $F_2(1, 31) = 15.71, p < .005$ ): participants were more likely to produce feminine responses after *in* 'and' (39.3% difference) than after *ali* 'or' (21.6% difference) when the first coordinand was feminine than when it was masculine. There was no interaction between second coordinand gender and coordinator ( $F_1(1, 70) < 1$ ;  $F_2(1, 31) = 1.11, p > .1$ ).

There was an interaction between first and second coordinand gender ( $F_1(1, 70) = 248.43, p < .001$ ;  $F_2(1, 31) = 68.13, p < .02$ ): participants were more likely to produce feminine responses following a feminine second coordinand than following a masculine second coordinand when the first coordinand was also feminine (67.7% difference) than when it was masculine (8.8% difference). There was no difference between feminine responses in the mixed coordinand conditions after *in* 'and' ( $F_1(1, 70) < 1$ ;  $F_2(1, 31) = 1.61, p > .1$ ) but after *ali* 'or', there was a significant difference ( $F_1(1, 70) = 24.15, p < .001$ ;  $F_2(1, 31) = 6.70, p < .02$ ).

Critically, there was a three-way interaction between coordinator, first and second coordinand, though this was marginal by items ( $F_1(1, 70) = 10.04, p < .001$ ;  $F_2(1, 31) = 3.73, p = .063$ ): although participants were more likely to produce feminine responses following a feminine second coordinand than following a masculine second coordinand when the first coordinand was also feminine than when it was masculine, this effect was significantly stronger with the coordinator *ali* 'or' (63.9% versus 10.0%) than after *in* 'and' (71.9% versus 1.6% difference).

*Neuter agreement*

There was a main effect of coordinator ( $F_1(1, 70) = 22.02, p < .001$ ;  $F_2(1, 31) = 8.48, p = .01$ ), with more neuter responses after *ali* 'or' than after *in* 'and'; and of first coordinand gender ( $F_1(1, 70) = 17.82, p < .001$ ;  $F_2(1, 31) = 5.03, p < .05$ ), with more neuter responses after a masculine than a feminine first coordinand; and of second coordinand gender by participants ( $F_1(1, 70) = 4.57, p < .05$ ) but not by items ( $F_2(1, 31) < 1$ ), with more neuter responses after a feminine than a masculine second coordinand. There was no interaction between first coordinand gender and coordinator ( $F_1 < 1$ ;  $F_2(1, 31) = 1.02, p > .1$ ): participants were not significantly more likely to produce neuter responses after *in* 'and' (3.9% difference) than after *ali* 'or' (4.9%) when the first coordinand was masculine than when it was feminine. There was an interaction between second coordinand gender and coordinator ( $F_1(1, 70) = 5.20, p < .05$ ) by participants but not by items ( $F_2(1, 31) = 3.04, p = .091$ ): participants were more likely to produce neuter responses when the second coordinand was masculine than when it was feminine after *in* 'and' (0.5%) than after *ali* 'or' (3.8% difference).

There was no interaction between first and second coordinand gender (all  $F_s(1, 70) < 1$ ): participants were not more likely to produce neuter responses following a masculine second coordinand than following a feminine second coordinand when the first coordinand was also feminine than when it was masculine (FM minus FF = 1.6% versus MM minus MF = 2.7% difference). There was a numerical difference between neuter responses in the mixed coordinand conditions (marginal by items) after *in* 'and' ( $F_1(1, 70) = 6.89, p < .02$ ;  $F_2(1, 31) = 3.84, p = .059$ ); the difference was significant by participants only after *ali* 'or' ( $F_1(1, 70) = 10.60, p = .002$ ;  $F_2(1, 31) = 2.22, p > .1$ ).

Critically, there was a three-way interaction between coordinator, first and second coordinand by participants ( $F_1(1, 70) = 4.67, p < .001$ ;  $F_2(1, 31) = 2.21, p > .1$ ): participants were more likely to produce neuter responses following a masculine first coordinand than following a feminine first coordinand when the second coordinand was feminine than when it was masculine, after the disjunction *ali* 'or' (0.5% versus 7.1% difference), but after the conjunction *in* 'and' the effect was weaker after feminine heads (1.2%) and reversed after masculine heads (-0.2% difference).

response	Conjunct gender (first conjunct, second conjunct)							
	in		'and'		ali		'or'	
	MM	MF	FM	FF	MM	MF	FM	FF
fem	9.2	10.8	13.3	85.2	10.8	28.8	9.4	73.3
masc	84.6	83.1	86.7	13.6	81.1	56.1	83.0	18.7
neut	6.2	6.0	0	1.2	8.1	15.2	7.5	8.0

Table 5.14: Experiment 9 - percentages of all gender agreement produced

Finally, the special preamble, *groza in strah*, which has been claimed to exemplify furthest-conjunct agreement (Corbett, 1991), failed to induce much feminine singular (furthest-conjunct) agreement. There were only twenty-five responses including gender agreement; of these, sixteen were masculine (of which 13 were dual and three singular), four were neuter (singular) and five were feminine (of which three were dual and two were singular).

### 5.7.6 Discussion

Experiment 9 set out to discover what pattern of gender agreement Slovene speakers produce following conjoined noun phrases and whether this differs depending on coordinator type.

Experiment 9 provided more evidence that the gender of the coordinands can have an effect on the rate of single-conjunct agreement. It was found that participants were particularly likely to produce feminine agreement when both coordinands were feminine, and masculine agreement when one of the coordinands was masculine. Feminine agreement was produced more often directly following a feminine rather than a masculine conjunct. Neuter agreement was not produced often.

Experiment 9 adds to the evidence that speakers use more than one agreement strategy. There is evidence for a resolved strategy with resolved (masculine) agreement the dominant response after one or more masculine conjuncts. However, there is also evidence of single-conjunct agreement - feminine agreement was found after two after mixed gender conjuncts as well as after feminine conjuncts. Kempe and Vigliocco (2001) suggest that the reason why participants in their experiments and in the experiments of Vigliocco & Franck (1999) make more errors with the feminine than the masculine gender (i.e. produce more erroneous masculine than feminine forms) is because “speakers are more likely to

omit rather than add a suffix". In an experiment examining only singular responses, it is difficult to distinguish this explanation from that of the masculine being the unmarked default. This experiment does distinguish these two: although masculine (and feminine) singular appear in our preambles, the outcome is not necessarily singular, thus we can compare whether there are more masculine than feminine responses, irrespective of whether the morphophonologically-unmarked masculine singular is used, or whether a morphophonologically-marked dual or plural form is used. The majority of the agreement is masculine (62.4%) but only a small proportion (9.3%) is masculine singular (compared to 5.2% neuter singular and 7.4% feminine singular), thus this cannot be attributed to omission of a suffix.

Experiment 9 tested whether a linear word order effect is found in gender agreement with conjoined nouns. The results showed that the order of the coordinands was relevant: there was more masculine agreement directly following a masculine conjunct and more feminine agreement directly following a feminine conjunct. This is evidence that, of the two possible partial agreement strategies, nearest- and not furthest-conjunct agreement is preferred (contra Corbett, 1991). If word order affects gender agreement, this is inconsistent with an approach which only takes account of syntactic information; linear word order may be implicated in deciding whether a target agrees with one or another coordinand in gender. This argues against the claim that agreement takes place before linear word order is specified (Vigliocco and Nicol, 1998).

Experiment 9 tested whether the linear word order effect found in gender agreement with conjoined nouns may be modified according to which coordinator conjoins the coordinands. As predicted, the disjunctive 'or' leads to more agreement with the nearest conjunct than the alternative conjunction 'and'. Experiment 9 provides stronger evidence for the patterns found in the previous experiment, with little difference between feminine and masculine responses when at least one of the coordinands is masculine when the coordinator is 'and', but when the coordinator is 'or', there is a significant increase in the number of responses which match the nearest coordinand in the mixed coordinand conditions. There are also neuter responses produced; these are more common directly after a feminine than a masculine coordinand in the mixed coordinand conditions, and more common after 'or' than 'and'.

The coordinator used appeared to have an effect, with more nearest-conjunct agreement possible with the disjunction *ali* than with the conjunction *in* and

more neuter agreement with the disjunctive *ali* too, and this must be analysed as reversion to neuter singular as the default or else random errors, since there were no neuters even in the filler items. The conjunctive *in* results in more masculine; if we assume that this is resolved agreement, since the feminine and masculine combination is generally resolved to the masculine, then this implies that ‘and’ results in more resolved agreement than ‘or’.

Linear order is shown to affect even conjunctive coordination. The type of coordinator influences agreement, interacting with the gender of each coordinand. This means that semantics interact with word order, thus implying that different types of information must be available at the same stage in order to contribute to agreement processing. This adds to previous findings of semantic effects interacting with morphophonological effects in agreement (Vigliocco et al., 1995).

This work provides the only known test of the celebrated furthest-conjunct agreement which is reported exclusively in Slovene (in fact, in the phrase *groza in strah*). After the famous phrase *groza in strah*, the majority of the agreement was masculine dual, or resolved agreement. The number of feminine responses differed little from that of neuter (whether we compare singular only or include dual responses), and there fewer instances of agreement with the furthest conjunct than with the nearest conjunct, thus under experimental conditions, it was not possible to provide support for the commonly-cited claim that Slovene shows furthest-conjunct agreement, even using the same collocated phrase.

## 5.8 General Discussion

Single-conjunct agreement was found to occur within both number and gender agreement with conjoined NPs. When the coordinands were of mixed number or gender, there was more agreement of type A when the A conjunct was nearest to the verb than when the B conjunct intervened between the verb and the A conjunct. The experiment fails to support the idea of furthest-conjunct agreement, even using the celebrated collocated phrase *groza in strah* associated in the literature with furthest-conjunct agreement, or for furthest-conjunct agreement in general. This is compelling evidence that nearest-conjunct agreement is preferred over furthest-conjunct agreement (Corbett, 1991). This is also incompatible with Johannessen’s (1998) claim that head-initial languages show agreement with the initial coordinand (and other “first-conjunct accounts”), but is compatible with a hierarchically-structured account of coordination as well as a flat-structured

account such as we have been assuming. Furthermore, these experiments show that single-conjunct agreement may occur with all number values and with conjunctive as well as disjunctive coordinators in Slovene (contra Bajec et al., 1956).

Previous work on linear agreement in psycholinguistics has been limited, and results were mixed. Importantly, these experiments provide unequivocal support in a hereto-untested language for the role of linear word order in spoken agreement processing, which cannot be accounted for in an account which only takes account of syntactic information; linear word order is clearly crucial in deciding whether a target agrees with one or another coordinand. This is inconsistent with the claim (Vigliocco and Nicol, 1998) that linear order occurs after agreement has been processed. Nearest-conjunct effects are incompatible with percolation up the syntactic tree because both conjuncts would have equal proximity in the syntactic tree to the head. This implies that either the Vigliocco and Nicol (1998) model of agreement processing is wrong, or that coordinated phrases work in a different way. Furthermore, the coordinator influences agreement. This suggests that the semantics of the coordinator interact with word order, thus implying that conceptual and positional information must be available at the stage when agreement is produced. This provides a new kind of semantic evidence to add to the existing findings of other semantic effects interacting with phonological effects in agreement (Hartsuiker et al., 2001), and suggests that interaction must be possible during agreement production, by means of either feedback (Dell, 1986) or self-monitoring (Levelt, 1983).

In a nonmodular interactive approach (e.g., Vigliocco & Hartsuiker, 2002b), there is a bi-directional flow of information between the lemma and lexeme levels, thus information from later stages can also play a role in agreement. If they are right, this suggests that linear word order must be processed before agreement is fully specified, which argues against a modular system with semantics and syntax (including agreement) being fully specified at the lemma level without access to information about later stages. I will return to this point in Chapter 6.

## CHAPTER 6

### Conclusions

#### 6.1 Introduction

This thesis has explored the complexities of how subject-verb agreement is processed in production by investigating agreement in a language with relatively complex number and gender systems. The first aim was to explore what agreement can tell us about models of language production. In the Levelt model of speech production (Bock & Levelt, 1994), information flows from the message level to the phonological level via the grammatical level. According to such an encapsulated system, agreement processing, which occurs at the grammatical level, should be immune to semantic influences except to the extent that they were available in the message. This thesis presents evidence against this view, showing that lexical semantics interacts with syntax, suggesting that feedback (at least) is necessary between the grammatical level and the message level. It presents further evidence against this view in the form of investigations into the role of linear word order in agreement processing, which shows that effects previously thought to occur later in production than agreement processing must also be able to wield an influence. I find interactions between lexical semantics and linear word order which show that any model of agreement processing must allow a significant degree of interaction and a flexibility in the direction of the flow of information during language production. The thesis assesses the most highly specified models of attraction errors in the light of new data and shows that neither Eberhard's (1997) model of markedness nor the more recent MMM model (Eberhard et al., 2005) can account for the patterns of data seen in Slovene or in English.

I will now discuss the results of Experiments 1-5 and their implications in detail before turning to experiments 6-9.

### 6.1.1 Experiments 1-5

#### *Results of Experiments 1-5*

Experiment 1 explored the role of markedness in Slovene number agreement. According to Eberhard's (1997) account of markedness effects in agreement, singulars are unmarked. It follows that encountering a non-singular head noun with a singular local noun intervening between it and the verb should not result in more agreement errors than encountering a non-singular head with a non-singular local noun, since singular nouns have no number feature to erroneously pass on. Errors occur at the point where the subject NP node is marked - it may be marked by the wrong element (Franck et al., 2002; Vigliocco & Nicol, 1998; Vigliocco et al., 1995, 1996a, 1996b).

Eberhard's (1997) account does not make any clear predictions about systems with more than a singular and a plural number value. Having extended Eberhard's markedness hypothesis in order to make predictions for a tripartite language system, I then tested whether singular attraction errors occurred and whether the dual caused more attraction errors than the plural.

These results showed that Eberhard's (1997) account is not correct. The singular was associated with attraction errors, contrary to the markedness hypothesis, according to which it has no feature with which to cause attraction. The dual was associated with many attraction errors, as predicted by the markedness hypothesis in view of its marked status. However, it was also extremely vulnerable to error, which was not predicted by the markedness hypothesis. Secondly, Experiment 1 clearly showed that dual and plural nouns differed in their agreement patterns, suggesting that any account of agreement has to consider a more complex characterisation of markedness than a simple binary account.

Experiment 2 built on the results of Experiment 1, investigating the agreement errors caused by a local noun within the subject NP. The results showed the same basic pattern as those in Experiment 1, with a strong dual attraction effect on a plural head noun. Contrary to Bock and Cutting (1992), who found that relative clauses encapsulated number such that there were few attraction errors following local nouns in relative clauses, Experiment 2 showed that, under certain

circumstances (namely, a highly morphologically rich language in which prepositional phrases induce non-nominative case marking in their complements), local nouns within PP post-modifiers may actually induce fewer errors than local nouns within relative clauses (Experiment 1).

Experiment 3 investigated semantic effects on agreement, replicating Experiment 2's three-way syntactic number distinction in English, which has a two-way number system, by introducing the quantifiers *two* and *many*. This experiment therefore examined whether making participants adopt an interpretation comparable to that of Slovene participants in Experiment 1 would lead to a similar pattern of agreement. The two quantifiers showed different patterns in both the head condition (*two* was associated with more singular errors following a singular local noun than *many*) as in Slovene, but also in the local noun condition (*two* was associated with more plural errors following a singular head noun than *many*), as in Slovene.

Experiment 4 replicated Experiment 3 but the participants had Slovene as their native language. The existence of a syntactic difference between *two* and *many* failed to reinforce the differences already found between the quantifiers in Experiment 3, showing that L1 syntax is at least not directly transferred from L1 to L2. In fact, the participants, though sensitive to the semantic difference between *two* and *many* in head noun position, failed to show any difference in local noun position.

Experiment 5 extended the research by examining the role of markedness in a different type of agreement, gender agreement, again in Slovene. The research that has been conducted on gender has tended to be restricted to the investigation of two-gender systems, and they are usually investigated with a view to establishing the influence of semantics or morphophonology on agreement processing, yet theoretical linguists have long stressed the importance of exploring more complex gender systems. This thesis provides the first known exploration of the pattern produced by all three genders in a tripartite system compared to each other. The experiment manipulated the gender of the head and local noun, and examined whether there were effects of the markedness of each. A complex pattern was found, with some evidence for reversion to a default gender (masculine in the case of ambiguous human nouns, neuter for collectives). There was a stronger neuter attraction effect on the masculine when the nouns were collective (atypically masculine; the more marked gender for the type is susceptible to attraction), and there was a stronger neuter attraction effect on the feminine

when the nouns were human (atypically neuter; the more marked gender for the noun type causes attraction), although differences were not significant.

#### *Implications of Experiments 1-5*

Experiments 1 and 2 show that the pattern of results in a more sophisticated number system is incompatible with current models of agreement. Furthermore, the results indicate that the number of random errors is not necessarily explicable in terms of a default (i.e. there is not only one form to which speakers revert when they make agreement errors, but there are different preferences depending on the head noun). I proposed that the notion of susceptibility is not the same as attractiveness, as the value associated with most attraction errors was not the least susceptible. Previous models have not made allowances for this. Markedness did not straightforwardly influence number agreement: although the most marked number was more likely to cause attraction errors, it was also extremely susceptible to errors. Hence it appears that the markedness hypothesis cannot explain number agreement, at least not without major alterations to how agreement is measured. Exploring a complex agreement system does, however, at least allow us to separate out susceptibility from attractiveness and to investigate these two factors separately.

I will now discuss the implications of the results of Experiments 1-4 for current models of agreement. Many language production models tend to position syntax strictly encapsulated from semantics and phonology. Agreement is regarded by psycholinguists as primarily a syntactic process which occurs at the functional level. This being so, there should not be any influence from outside the functional level during agreement processing. Evidence for the view comes from early agreement errors literature: phonology, length of intervening material, word order and semantics all failed to influence agreement errors whereas syntactic differences between complement clauses and relative clauses did (e.g., Bock and Cutting, 1992). Yet there is a growing wealth of evidence to suggest that semantics interacts closely with syntax, with effects including those of biological gender, plausibility, distributivity (e.g., Vigliocco and Franck, 1999; Hupet et al., 1998; Thornton and MacDonald, 2003; Humphreys and Bock, 2005); along with evidence of effects of morphophonological form and linear word order (e.g., Hartsuiker et al., 2001; Haskell and MacDonald, 2005). This thesis adds to the evidence that semantics and linear word order can influence agreement. Also, contrary to the claim that only elements within the main clause of a subject NP

can affect agreement error production, Experiment 1 (and also Experiments 3-5) showed that agreement errors occur even when the local noun is within a separate (relative) clause. There were, in fact, more agreement errors after a relative clause post-modifier (in Experiment 1) than a complement post-modifier (in Experiment 2). The explanation for this is case marking. The prepositions used in Experiment 2 all induced non-nominative case marking, thus the local nouns were not strong attractors (i.e. there were not a lot of agreement errors after these mismatching local nouns compared to the baseline of agreement errors after a local noun which matched the head noun in number). Conversely, there was no non-nominative case marking on the local nouns in Experiment 1, since they functioned as subjects of the relative clauses in question, thus they were strong attractors (i.e. there were many agreement errors after these mismatching local nouns compared to the baseline of agreement errors after a local noun which matched the head noun in number). This extends previous findings (Hartsuiker et al., 2003) which suggested that ambiguous determiners not marked for non-nominative case in German were associated with more errors.

I shall now consider the implications of the findings thus far for Meaning, Marking and Morphing (Bock et al., 2001; Bock, 2004; Eberhard et al., 2005) because it is the most influential and detailed model of this class. Note that percolation accounts seem to have relevant features and so make the same predictions, so the same implications would also hold for them. On the MMM account, agreement production consists of two processes, marking, which marks the entire noun phrase with an abstract number (or gender, or person, or any other agreement) value; and morphing, which implements grammatical agreement, the controller specifying the form of its number or gender on a particular target (e.g., a verb). Marking, it is claimed, can refer to semantics, but morphing is a process which only has access to syntactic information. Since the Singular-and-Plural (SAP) feature is positive for plural NPs and zero for unmarked singular NPs, a plural head noun is relatively immune to the influence of a singular local noun (which merely adds zero to the total count, thus it remains positive and thus the verb is plural in the same way as if the local noun had been plural). Conversely, a singular head carries a zero value; so if the local noun is plural, the resulting feature is positive, therefore the SAP will be above zero, and the outcome will be more likely to be plural than in the match (singular local noun) condition (where both nouns would contribute around zero to the total SAP). This explains the usual attraction effects (e.g., Bock & Miller, 1991). Features from other elements in the

noun phrase may also influence agreement, hence the effect of ambiguous determiners (Hartsuiker et al., 2003). Thus the indefinite determiners in Experiments 3 or 4 would have increased the likelihood of a singular attraction effect. Although there were no determiners in Experiments 1 and 2, and the masculine adjectives were unmarked (in exactly the same way as the nouns), it is possible that the use of the unambiguously-number-marked object clitic in the Slovene relative clause construction, caused the increase in singular attraction errors observed. This reveals a tension between the additional information which can emphasise the singular feature, and the details of case (as discussed above) may conflict; more specifically, if the local noun is marked as non-nominative singular, does this cause more agreement errors because it is providing a marked singular feature, or fewer, because it is marked as non-nominative?

The MMM account of agreement differs from the percolation account in that although both require the number (or other agreement feature) specification from the subject to the verb, and it may be that the number (or other agreement feature) of the local noun which intervenes during this process, both are predicated on a binary system and fail to account for the case where there are more than two values: if singular is 0 (or negative) and plural is a positive number, what is dual?

Experiment 3 provides some support for MMM with respect to the effects of the number of the head noun, because the semantics of the head noun is predicted to be available during the marking process. However, it provides evidence against this theory with respect to the effects of the number of the local noun, because attraction effects occur during morphing when only semantics are predicted to be available. These results are incompatible with any theory which does not allow semantics to influence agreement more freely. The pattern of results found in Experiment 4 is predicted by the MMM theory, since it suggests that the semantic difference of the head noun is available to influence agreement during the marking process, but that the semantics of the local noun is not available during the subsequent morphing process. However, the full pattern of results from Experiments 3 and 4 (i.e. the fact that native speakers are insensitive to the encapsulation of the syntactic process of morphing but that non-native speakers are not) is not explicable in terms of MMM. The finding that Slovenian speakers of English are not sensitive to semantic differences at the local noun may be due to the influence of participants' first language: the pseudo-dual (i.e. plural with *two*) is perhaps less marked or more predictable for speakers of a language with

a dual than for speakers of a language without one (the native speakers of English), thus rather than reinforcing the differences between *two* and *many*, the L1 would render them less marked. It would therefore be logical to expect a semantic difference between *two* and *many* amongst the L1 speakers with more plural errors after a *two* local noun. This also explains the semantic difference found between *two* and *many* amongst the L1 speakers in the head noun position, with more errors after *two* than after *many*. Note that this is actually predicted by the Markedness Differential Hypothesis, which predicts that unmarked features in L1 are more likely to transfer to L2, whereas marked features in L1 (such as dual number) will not transfer. Furthermore, this is in line with past research suggesting that processing resources (assumed to be limited in L2 compared to L1) influence sensitivity to semantics in agreement. This does not explain why the Slovenians show a difference in head position but not in local noun position. To explain this, it would be necessary to claim that the head differences are much more salient. However, given that the head is usually the controller of grammatical agreement in both English and Slovene, and that the local noun is assumed to merely create occasional errors, this is not a difficult position to adopt.

Having considered the implications for MMM, I will now consider the implications for a model in which multiple cues may influence agreement, such as a head-misselection (Bates and MacWhinney, 1989) or constraint-satisfaction (Haskell and MacDonald, 2005) account. The results are also broadly compatible with a constraint-satisfaction account, if we assume that the constraints may differ between speakers with differing resources available during production. The computation of agreement is claimed by proponents of this view to be a process whereby multiple sources of information are integrated. For instance, distributional information about the regularity with which plural verbs occur directly after singular nouns (with modals, subjunctives, coordinated phrases, collectives) compared to the infrequency with which singular verbs occur directly after a plural noun would contribute to the pattern of asymmetry often observed between singular and plural attraction effects in English (Haskell et al., 2005). Not all sources of information necessarily influence agreement to the same extent. This type of account does not explain how the relative influences of head and local noun are decided, however.

In summary, the results of Experiments 1-4 suggest that the markedness hypothesis (put forward by Eberhard, 1997, and developed in the MMM model) is inadequate. Experiments 1-2 suggest that the markedness explanation used

by Eberhard to explain number agreement in English cannot be applied cross-linguistically, as it is too simplistic. The idea that the singular is incapable of causing errors is clearly untenable - it appears, rather, that singular attraction errors are often swamped by other (random) errors. The dual is clearly associated with errors. Although it is not only error-causing but also extremely sensitive to errors. Any model of agreement would have to account for singular attraction effects being stronger than plural attraction effects, and would need to be able to account for systems with more than two number values. These experiments show that it is important to separate out susceptibility to agreement errors and attractiveness. This does not mean that the concept of markedness is not useful, only that it has been over-interpreted.

One final finding concerns the difference between native speakers of English and their Slovene counterparts. The latter showed sensitivity to the semantics of the head noun but not the local noun, whereas L1 speakers showed sensitivity to both. Previous accounts have been mixed. Nicol and Greth (2003) found no difference between speakers' L2 (Spanish) and L1 (English) sensitivity to distributivity; similarly, Hoshino et al. (2004) found that semantic effects were present in the L1 and L2 of Spanish-English bilinguals, though there were some differences (depending on L2 speakers' competence). It is possible that we could explain these findings in terms of working memory constraints, but since the L2 speakers were advanced English speakers and were given more time than the L1 speakers, and were sensitive to the head noun differences, it is difficult to be certain. An alternative explanation is that the Slovene native speakers are not as sensitive to the semantic differences between *two* and *many* as the English native speakers because they have this distinction in the syntax. This fails to account for the head noun effects (although they are stronger, the magnitude of the effects and the striking similarities between the head noun effects in the two experiments makes it unlikely that the lack of local noun effects in Experiment 4 could be due to floor effects).

The more recent Meaning, Marking and Morphing model is also inadequate because it, too, is incapable of dealing with a tripartite number system, although it can better account for results with a probability distribution than the original markedness hypothesis. Moreover, the results of Experiment 3 present a difficulty to the MMM model which allows semantic influence only from the head noun. Any model of agreement would have to allow the semantics of the local noun to influence the head noun. Generally, the results of Experiments 1-4

suggest that agreement processing is influenced by multiple factors within and outside syntax, which is compatible with a language production model which involves feedback or interaction between different levels.

Experiment 5 shows that semantics may well have a role to play within gender agreement processing just as Experiments 3 and 4 showed that semantics plays a role in number agreement processing. We might expect differences with human nouns with relation to gender, since their ambiguity is precisely defined in terms of a relationship between biological (conceptual) and grammatical gender, but importantly, Experiment 5 suggests that agreement differs in different types of noun, even when gender is apparently irrelevant, as in the case of collective nouns. Results were mixed and were not significant, but there was a tendency towards different attraction effects depending on noun type. This suggests that the grammatical gender of nouns is not entirely arbitrary, but is intricately bound up in the semantics of the noun, and therefore that semantics and syntax both play a crucial role in agreement processing. Given that the effects were not reliable, however, more research is needed to verify this.

Experiment 5 is important because most psycholinguistic studies of agreement examine only number and assume that the precise domain of agreement is immaterial, that the results will generalise to all forms of agreement, but it is not clear whether gender works in the same way as gender agreement in processing. Crucially, in number, there seems to be a distinction between singular and non-singular followed by a distinction within non-singular between dual and plural, although dual errors are frequent after a singular head noun and vice versa. In gender, it is not obvious if we should distinguish between neuter (which cannot refer to biological gender) and masculine and feminine (which can), or perhaps between feminine (which is not a default or generic) and masculine and neuter (which can be a default or generic). Gender is inherent whereas number is (mostly) discourse-dependent, thus, as Experiment 5 shows, which gender is more marked depends on the semantics of the noun (e.g., whether it is human) whereas in number, it depends on the particular instantiation of the noun (whether there is more than one token) Of course, there are numerous counterexamples in number (pluralia tantum, collectives, distributive versus non-distributive readings) but rarely in gender (gendered nouns referring to humans, arguably). Although there appears to be a similar pattern of agreement errors with one strong attractor (dual / neuter), the crucial difference between number and gender is that whilst the strong number attractor is unarguably the

most marked form, it is far from clear that the same is true for gender. We therefore need to study both number and gender agreement (and indeed other types of agreement such as person) so that we can find out how agreement works in order to develop a comprehensive model of agreement processing in language production. Parsimonious though it would be to come up with a unitary account of agreement, along with research from Deutsch and Dank (2009, although c.f. Antón-Méndez et al., 2002), my experiments suggest that this is not possible (or right): gender agreement and number agreement seem to be processed in different ways.

### 6.1.2 Experiments 6-9

#### *Results of Experiments 6-9*

Experiments 1-5 examined agreement in cases where the subject noun phrase involved two nouns, a head noun and a local noun, where one of the nouns (the head noun) should control agreement on the verb. In Experiments 6-9, I moved on to consider a more complex situation, coordination, where the subject noun phrase involved two nouns, either or both of which could control agreement on the verb. Considering both number and gender agreement, I sought to investigate whether linear order influenced agreement and also, when agreement is with only one conjunct, whether it is with the first or second.

Experiment 6 sought to investigate whether the first conjunct, second conjunct or the sum of the two is used in the production of agreement. The results showed that agreement with a single conjunct occurred. Additionally, participants sometimes used resolved agreement (a summation strategy), perhaps surprisingly given that the disjunctive conjunction *ali* 'or' was used.

Most existing theories of agreement (e.g., Vigliocco and Nicol, 1998) assume that syntax (including agreement) occurs before word order is decided. Thus they cannot account for pure word order differences. Experiment 6 provided evidence for an influence of linear word order in agreement production, with participants producing more singular agreement directly after a singular conjunct and more dual agreement directly after a dual conjunct. This argues against a purely syntactic account and suggests access to so-called later processes or a more interactive account of agreement processing.

Experiment 7 further investigated number agreement in Slovene coordinated phrases. This time, the conjunction *in* 'and' was used, and singular and plural conjuncts were tested. According to the literature, both of these factors should encourage plural agreement. The conjunctive *in* 'and' is associated with an increase in resolved agreement because when conjoined by 'and', both conjuncts are necessarily associated with the predicate together whereas with the disjunctive *ali* 'or', at least in the case of an exclusive 'or' reading, only one of the conjuncts is associated with the predicate. Plural agreement is more likely because it is available both as resolved agreement and as single-conjunct agreement whenever it occurs. Nonetheless, single-conjunct agreement was again found, though to a lesser extent than with disjunctive *ali* 'or' and with duals instead of plurals. The results suggest that the conjunction used affects agreement with coordinated phrases, as does the number value of the conjuncts, since in the singular-singular conditions, there was much more resolved (dual) agreement after *in* 'and' than *ali* 'or'. Experiment 7 also provided further support for the influence of linear word order in agreement production, and for single-conjunct agreement to be with the nearest conjunct.

Experiment 8 investigated gender agreement in coordination. Gender agreement necessarily differs from number agreement in that resolved agreement is not merely a sum of the two conjuncts, but requires the choice of the correct resolved form, which is not calculable from the semantics of the conjuncts alone. More masculine agreement was found directly after a masculine conjunct than a feminine one and more feminine agreement was found directly after a feminine conjunct than a masculine one. The results of Experiment 8 provide support for an influence of linear word order in gender as well as number agreement production. Likewise, they suggest that in Slovene gender as well as number agreement, single-conjunct agreement is preferentially with the nearest rather than the furthest conjunct.

Experiment 9 again investigated gender agreement, but this time the two conjunctions *in* and *ali* were directly compared. The type of conjunction was shown to influence agreement, with more feminine nearest-conjunct agreement produced after a disjunctive *ali* 'or'. This suggests that the disjunctive conjunction is indeed associated with single-conjunct agreement as the semantics of the two conjunctions suggest. The gender of the noun in both first and second position was found to affect gender agreement, but it was more pronounced for feminine than masculine. That there was not more masculine agreement with the nearest

conjunct after 'or' than after 'and' is doubtless because masculine agreement can be both resolved and single-conjunct agreement, thus there is a danger of the single-conjunct agreement being swamped by the resolved agreement.

#### *Implications of Experiments 6-9*

Experiment 6-9 investigated whether there was an effect of word order on agreement processing and whether the first conjunct, second conjunct or a combination of the two (resolved agreement) is used in the production of agreement. The results showed that there was an effect of linear word order for both gender and number agreement. Participants preferred the nearest to the furthest (first) conjunct in single-conjunct agreement. Resolution was another strategy used alongside single-conjunct agreement. Resolution was more common with the conjunctive coordinator *in* 'and' than the disjunctive conjunction *ali* 'or', but both strategies were used after both coordinators.

Most psycholinguistic theories (e.g., Kempen & Hoenkamp, 1987; Levelt, 1989) assume that agreement is computed during the construction of the hierarchical structure, and that syntactic frames are constructed before words are linearly ordered. If this is the case, then we would expect the occurrence of agreement errors to be affected by the syntactic proximity of a local noun to a head noun, but not by their linear proximity. Evidence to support this view comes from research showing that participants produce an equal number of agreement errors whether the local noun intervenes between the head noun and verb or not (Vigliocco & Nicol, 1998). However, Experiments 6-9 show that linear word order can influence agreement processing in coordinated phrases, therefore either it is not computed after agreement, or, if linear word order is computed after agreement, then information must be available via feedback or some process which allows for interactivity and modulation of syntactic frames by subsequent positional processes (contra Vigliocco and Nicol, 1998). In Vigliocco and Nicol's (1998) model, agreement errors occur through percolation up the syntactic tree, but in the case of coordinated phrases, both conjuncts would have equal syntactic proximity to the head noun. This implies that either the Vigliocco and Nicol (1998) model of agreement processing is wrong, or that coordinated phrases work in a different way.

Furthermore, the type of coordinator employed influences agreement. This suggests that the semantics of the coordinator interacts with word order, thus implying that conceptual and positional information must be available at the stage

when agreement is produced. On the Levelt (1999) account, whilst the semantics of the coordinator would be assumed to be available at the message level, it is not clear how the order of the conjuncts could be available prior to syntactic formulation; similarly, whilst we could assume that agreement takes place after linear order has been decided in order to allow for that interaction, this would cause enormous problems for explaining such phenomena as stranding errors. Furthermore, an encapsulated syntax account might attribute agreement variability to subject selection variability, this is not possible where linear order effects are found, since subject selection would perforce take place before linear order had been determined (Bock & Levelt, 1994). This finding provides a new kind of semantic evidence to add to the existing evidence that semantics interacts with phonological effects in agreement (Hartsuiker et al., 2001), and suggests that interaction must be possible during agreement production, by means of either feedback (Dell, 1986) or self-monitoring (Levelt, 1983) or by means of a less constrained system such as in a constraint-satisfaction model. In a non-modular interactive approach (e.g., Vigliocco & Hartsuiker, 2002b), there is a bi-directional flow of information between the lemma and lexeme levels, thus information from later stages can also play a role in agreement. If they are right, this suggests that linear word order must be processed before agreement is fully specified, which argues against a modular system with semantics and syntax (including agreement) being fully specified at the lemma level without access to information about later stages.

Previous work on linear agreement in psycholinguistics has been limited, and results were mixed. The experiments reported in this thesis provide unequivocal support in a hereto-untested language for the role of linear word order in agreement processing, which cannot be accounted for in an account which relies on percolation up the syntactic tree, but fits with a proximity-based account. Nearest-conjunct agreement is shown to be a popular strategy in Slovene. This is incompatible with Johannessen's (1998) claim that head-initial languages show agreement with the initial conjunct (and other "first-conjunct accounts") but is compatible with a hierarchically-structured account of coordination as well as a flat-structured account such as we have been assuming. This means that any account of syntactic processing must allow word-order information to be available early enough to affect agreement.

Note also that Experiment 8 provides the only known test of the celebrated furthest-conjunct agreement which is reported exclusively in Slovene. Within

theoretical linguistics, agreement with a single conjunct is often referred to as first-conjunct agreement but is still compatible with a nearest-conjunct-based explanation because cross-linguistically, agreement with a single conjunct occurs most often when the subject follows the verb. Slovene is the famous counter-example because of the oft-repeated Example 253.

- (253) groza in strah je prevzela vso vas  
 horror.F and fear.M AUX.SG taken.over.SG.F whole village  
 ‘Horror and fear has taken over whole village’

Experiments 6-9 showed nearest- rather than furthest-conjunct agreement to be the more popular strategy, even after this particular example, despite Slovene’s fame for furthest-conjunct agreement. The experiment fails to support the idea of furthest-conjunct agreement, either for the particular collocated phrase, or for furthest-conjunct agreement in general. This experiment underlines the importance of empirical research to support or refute the claims of theoretical linguistics. Claims are often taken for granted but may not be borne out when tested. This thesis emphasises the benefits of interdisciplinary research - linguistic theories can contribute to the development of more comprehensive psychological theories (such as providing psycholinguistics with a markedness hierarchy) but equally, psycholinguistic experiments can provide empirical data to test the predictions of linguistic theories.

### 6.1.3 *A model of agreement processing*

I now consider what a model of agreement processing would look like based on previous work and the results reported in this thesis. Any model would need to be able to accommodate multiple distinctions in agreement features in order to account for the differences found between the three number values in Slovene (Experiments 1 and 2), for instance with more than two dimensions so that all three number values could be independently related to each other. It would also need to also degrees of number (and other agreement features) such that the value plural, say, is not a binary (on / off) value, but can be weighted. There is evidence (Antón-Méndez et al., 2002) that agreement functions differently in gender and number (and other types of agreement), such that separate models would be required. Any model would need to be able to account separately for the influences of susceptibility to errors and attractiveness (the tendency to cause errors). Any model of agreement would have to allow the semantics of

the local noun to influence agreement too in order to account for the finding that the semantics of the local noun influences agreement (Experiment 3). It would also need to account for processing load, since there is some evidence (including arguably from Experiment 4) that higher processing loads mean less sensitivity to fine-grained cues for agreement. Any model would need to allow linear word order to influence agreement, and even interaction between positional encoding and semantics (Experiments 6-9) and phonology (e.g., Hartsuiker et al., 1999). The results presented here, combined with the data reported by others (e.g., Haskell and MacDonald, 2005), showing that the position of the nouns influences agreement errors, strongly suggest that agreement errors arise as a consequence of linear proximity. Therefore these results suggest an architecture in which assigning grammatical roles and building hierarchical structures are not entirely separate from assigning word order. This means that the model would need to be interactive, with feedback or some other interactive approach. The interaction would need to be limited, however, with some way of weighting different elements so that, for example, the head noun would be more influential than the local noun in deciding agreement feature values.

## 6.2 Further work

In psycholinguistics, there is a tendency to rely on the most accessible world-dominant languages rather than many natural languages which have more complex number systems than English (something that is clear if one compares the theoretical linguistic literature). Since we are interested in how language processing works in language, rather than in a particular language (or sub-set of languages), it is imperative that psycholinguistic methods of investigation are used in the study of languages which have other features. I have already argued in favour of more exploration of languages with a more complex number system than those usually favoured by psycholinguists, and I would reiterate that with respect to gender. Whilst it is arguably difficult to find large groups of participants who speak languages with more complex number systems than Slovene, the same cannot be said of gender. Work on gender has been restricted to the investigation of two genders, and that usually indirectly, yet theoretical linguists have long stressed the importance of exploring more complex gender systems. It would be interesting to look at languages with other number systems (e.g., with a paucal; a four-value system) and also to look at languages with other

gender systems (e.g., a four-value system) or both (Bantu languages would be interesting from the point of view of investigating gender and number interaction). Indeed, interesting though it is to compare Spanish (with its agglutinative number and gender morphemes) and Slovene (with its portmanteau morphemes), if we were to study languages such as Swahili, in which although there are not separate additive gender and number morphemes, gender and number are usually understood to be part of one system of classes, we might discover other ways in which gender and number interact.

In Chapter 3, a semantic difference between the effects of *two* and *many* was reported, whereby there were more plural errors after a plural local noun preceded by *two* than *many* and more singular errors after a plural head preceded by *two* than *many*, but these words differ in more than just numerosity. It would therefore be interesting to compare other numbers such as *six* and *ten*. If the previous results are attributable to processing load in that *two* is more complex (because more specific) than *many*, then *six* should be equivalent to *two* (as opposed to *many*). If the previous results are instead due to numerosity, *six* should be equivalent to *many* (as opposed to *two*). If frequency can explain my results, then this should also be evident.

In Experiment 4, Slovenes failed to show the sensitivity to the semantics of the local noun shown by native speakers of English. If the results are due to *two* being less marked for Slovene speakers due to it being syntactically encoded in their native language, then native speakers of a language with no dual should not show this difference between head and local nouns. If the lack of effects in the Slovenes is due to their processing load (Hoshino, 2003) then any other non-native speakers of the same ability should show the same pattern of results.

Another interesting area worth pursuing in agreement research is that of animacy. The limited evidence from Chapter 4 suggests that there may be a role for animacy in agreement despite previous suggestions to the contrary. This would be fairly easy to test whilst controlling for plausibility for, at least in English, animate and inanimate objects can be subjects of the same verbs<sup>1</sup>. The gender experiment in this chapter, which suffered from a lack of power, could be replicated in Russian, which has a higher proportion of neuter nouns.

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<sup>1</sup>We can of course argue as to what extent inanimate objects are the subject, but that is well beyond the scope of this thesis.

The conjuncts experiments offered just a sample of the logical possible combinations. It would be interesting to test dual and singular nouns using the conjunctive *and* to see whether the dual is still a popular completion. It would likewise be interesting to compare conjunctive and disjunctive conjunctions in number and to compare these directly with gender: does type of agreement feature (number or gender) after the conjunction used?

Considering the interesting finding from Chapter 2 that the dual is such a strong attractor compared to the plural (and to a lesser extent, that the plural has such a strong attraction effect on the dual), it would be interesting to test whether the dual could induce single-conjunct agreement when coupled with the plural, especially, since, as noted above, the plural encourages resolved agreement. Likewise, the latter could be tested more directly by a comparison of number agreement including a plural and number agreement excluding a dual.

Prescriptively, any pair of conjuncts except two feminines induces masculine agreement in Slovene. It would be interesting to test whether this is the case for pairs such as feminine and neuter, or whether the highly marked status of the neuter might induce neuter agreement instead. Likewise, neuter and masculine could also be tested - markedness, nearest-conjunct or resolved agreement might all potentially influence the outcome.

Finally, three conjuncts could also be tested to ascertain whether the number of conjuncts influences agreement. Also, earlier work (Franck et al., 2002) suggests that the second of three nouns influences agreement. This has been assumed to be structural, but if it was found that the second of three conjuncts influenced agreement, this would suggest a reanalysis of that assumption.

The experiments presented show what influences agreement processing, but that work needs to be done to model actual processing. My thesis identifies influences, but not how those influences come to bear.

### 6.3 Conclusions

Overall, I have shown in this thesis that agreement involves many different factors: markedness, semantics, linear word order. I show that although markedness is a useful concept in agreement, a binary distinction based on a two-value system simply does not work. This thesis has also shown that susceptibility to attraction errors is not inversely related to attractiveness, but that both need to

be investigated separately. It shows a binary marked/unmarked system does not hold, and that it is necessary to account for multiple values of agreement features. This thesis demonstrates that semantic information from both the local noun and the head noun are used in agreement processing. This means that the process of agreement instantiation cannot be blind to semantics. This thesis further asserts that linear word order can affect agreement, necessitating interactivity rather than a unidirectional flow of information from encapsulated language modules. I have also shown that the current models are problematic because they are based on morphologically-bereft languages such as English, and that there is a real need to use data from a variety of languages in order to formulate and test our models. I also show that number and gender do not behave the same in agreement, and therefore attempting to model all agreement by only examining number is far too simplistic. The research presented in this thesis has shown that the determination of agreement in language production is a complex phenomenon. By examining a language with a more complicated agreement system than those usually studied, I have shown that existing theories of agreement cannot account for patterns of agreement. It is clear that if we want to understand agreement, future work will need to look at different types of agreement in languages with complicated agreement systems.

## APPENDIX A

### Abbreviations

Throughout the thesis, I use the morphological gloss conventions of Leipzig Glossing Rules (LGR). The most recent version of the LGR can be found at: <http://www.eva.mpg.de/lingua/files/morpheme.html>.

The most commonly used abbreviations are as follows:

A dash (-) is used to highlight a morphological boundary; a dot (.) is used in other instances. Capital letters are used to denote sign language words, as well as morphological gloss terms.

SG	singular
DU	dual
PL	plural
M	masculine
F	feminine
N	neuter
C	common
I	first gender / class
II	second gender / class
NOM	nominative
ACC	accusative
GEN	genitive
DAT	dative
LOC	locative
INSTR	instrumental
ERG	ergative
AUX	auxiliary
PPL	participle
IMPFV	imperfective verb
PRFV	perfective verb
FUT	future
ANIM	animate
REFL	reflexive
1	first person
2	second person
3	third person

Table A.1: Abbreviations used in this thesis

## APPENDIX B

### Pre-test questionnaire

#### *Vaši podatki*

Prosim vas, da najprej izpolnite osebne podatke.

Spol.....Starost.....Letnik.....Smer.....

Materni jezik(i).....Drugi jeziki, ki jih znate.....

Pokrajina(e) v kateri(h) ste preživeli otroštvo.....

Podpis.....Datum.....

#### Navodila

Podanih je 80 primerov. Pri vsakem primeru, sta podana dva samostalnika (npr. ladja ali pa gospodična), glagol (npr. BATI SE) in lestvica števil od 1 do 7. Vaša naloga je, da ocenite kateri samostalnik se najboljše ujema s podanim glagolom. Če je ujemanje desnega samostalnika s podanim glagolom nemogoče, potem obkrožite številko 1. Stevilko 7 obkrožite, če je ujemanje levega samostalnika z glagolom nemogoče. V primeru delnega ujemanja samostalnika z glagolom, izberite številko, ki najboljše ponazarja razmerje ujemanja samostalnikov z glagolom. Če se oba samostalnika enako ujemata z glagolom, potem izberite številko 4.

Recimo, da imamo naslednje primere.

A.....minister.....1....2....3....4....5....6....7.....zakon  
.....ZASTARATI.....

Ker minister ne more zastarati, zakon pa lahko, izberemo v tem primeru številko 7.

B.....lovec.....1....2....3....4....5....6....7.....gospodična  
.....STRELJATI.....

Teoretično je možno, da bo streljala gospodična vendar je veliko bolj verjetno, da bo streljal lovec. Zato obkrožimo številko 2.

C.....ladja.....1....2....3....4....5....6....7.....riba  
.....PLAVATI.....

Ker plavajo tako ladje kot ribe, bi v tem primeru obkrožili 4.

D.....pravnik.....1....2....3....4....5....6....7.....punčka  
.....BATI SE.....

Tako pravnika kot pa punčka se lahko boji, vendar je bolj verjetno, da se boji punčka. Zato izberemo številko 5.

Če je kakšna napaka pri črkovanju, vas prosim, da jo samo popravite in nadaljujete z reševanjem. Če mislite, da se glagol ne ujema z nobenim samostalnikom, potem ob strani napišite razlago neujemanja.

Hvala lepa - Annabel Harrison

## Naloga

- 1.....klobučar.....1...2...3...4...5...6...7.....frizer  
 .....PRETIRAVATI.....
- 2.....policist.....1...2...3...4...5...6...7.....upravičenec  
 .....UPRETI SE.....
- 3.....pevec.....1...2...3...4...5...6...7.....bolnik  
 .....ZBOLETI.....
- 4.....kriminalec.....1...2...3...4...5...6...7.....politik  
 .....PRIZNATI.....
- 5.....stric.....1...2...3...4...5...6...7.....nečak  
 .....KLEPETATI.....
- 6.....učitelj.....1...2...3...4...5...6...7.....učenec  
 .....ZMOTITI SE.....
- 7.....vohun.....1...2...3...4...5...6...7.....volk  
 .....POBEGNITI.....
- 8.....gledalec.....1...2...3...4...5...6...7.....igralec  
 .....SKRIVATI SE.....
- 9.....zajec.....1...2...3...4...5...6...7.....pes  
 .....SKAKATI.....
- 10....Francoz.....1...2...3...4...5...6...7.....rak  
 .....HODITI.....
- 11....novinar.....1...2...3...4...5...6...7.....študent  
 .....SPREMENITI SE.....
- 12....pajek.....1...2...3...4...5...6...7.....tekmovalec  
 .....IZGUBITI.....
- 13....losos.....1...2...3...4...5...6...7.....ribič  
 .....PLAVATI.....
- 14....sršen.....1...2...3...4...5...6...7.....cvetličar  
 .....ZNORETI.....
- 15....stol.....1...2...3...4...5...6...7.....kadilec  
 .....POBLEDETI.....

- 16....sodnik.....1...2...3...4...5...6...7.....morilec  
.....GREŠITI.....
- 17....kanu.....1...2...3...4...5...6...7.....veslač  
.....POTOPITI SE.....
- 18....čoln.....1...2...3...4...5...6...7.....tanker  
.....RAZLETETI SE.....
- 19....turist.....1...2...3...4...5...6...7.....tat  
.....SMEJATI SE.....
- 20....zdravnik.....1...2...3...4...5...6...7.....skladatelj  
.....ZAJTRKOVATI.....
- 21f...strup.....1...2...3...4...5...6...7.....tujec  
.....POLITI SE.....
- 22....organizator.....1...2...3...4...5...6...7.....plezalec  
.....NAPITI SE.....
- 23....računalnik.....1...2...3...4...5...6...7.....Avstrijec  
.....DELATI.....
- 24....lovec.....1...2...3...4...5...6...7.....okel  
.....IZGUBITI SE.....
- 25....deček.....1...2...3...4...5...6...7.....tiger  
.....ŠEPATI.....
- 26....konj.....1...2...3...4...5...6...7.....ovinek  
.....ZAVITI.....
- 27....angel.....1...2...3...4...5...6...7.....pijanec  
.....GUGATI SE.....
- 28....čarovnik.....1...2...3...4...5...6...7.....vitez  
.....JEZITI SE.....
- 29....gobar.....1...2...3...4...5...6...7.....medved  
.....UMRETI.....
- 30....sodelavec.....1...2...3...4...5...6...7.....članek  
.....USPETI.....
- 31....krivolovec.....1...2...3...4...5...6...7.....kmet

- .....ORATI.....
- 32....fant.....1...2...3...4...5...6...7.....dedek  
.....TEČI.....
- 33....kamen.....1...2...3...4...5...6...7.....smučar  
.....ODLETETI.....
- 34....nebotičnik.....1...2...3...4...5...6...7.....poslovnež  
.....PROPADATI.....
- 35....jastog.....1...2...3...4...5...6...7.....gasilec  
.....ZAŽGATI SE.....
- 36....rudar.....1...2...3...4...5...6...7.....stenj  
.....POČRNETI.....
- 37....raziskovalec.....1...2...3...4...5...6...7.....slavist  
.....OBJAVLJATI.....
- 38....masker.....1...2...3...4...5...6...7.....maneken  
.....ZEHATI.....
- 39....kozolec.....1...2...3...4...5...6...7.....lesar  
.....ZRUŠITI SE.....
- 40....hišnik.....1...2...3...4...5...6...7.....ljubimec  
.....GOVORITI.....
- 41....travnik.....1...2...3...4...5...6...7.....otrok  
.....RASTI.....
- 42....čevljar.....1...2...3...4...5...6...7.....čevelj  
.....POPUSTITI.....
- 43....martinček.....1...2...3...4...5...6...7.....maček  
.....ODPLAZITI SE.....
- 44....vrtnar.....1...2...3...4...5...6...7.....šopek  
.....DIŠATI.....
- 45....kolesar.....1...2...3...4...5...6...7.....motor  
.....PREVRNITI SE.....
- 46....kamion.....1...2...3...4...5...6...7.....avtomobil  
.....RAZBITI SE.....

- 47....pešec.....1...2...3...4...5...6...7.....motorist  
 .....ODKORAKATI.....
- 48....vlak.....1...2...3...4...5...6...7.....avion  
 .....PELJATI.....
- 49....matador.....1...2...3...4...5...6...7.....bik  
 .....RANITI SE.....
- 50....botanik.....1...2...3...4...5...6...7.....trn  
 .....ZBOSTI.....
- 51....natakar.....1...2...3...4...5...6...7.....profesor  
 .....ODITI.....
- 52....kotalkar.....1...2...3...4...5...6...7.....sprehajalec  
 .....OPOTEKATI SE.....
- 53....projekt.....1...2...3...4...5...6...7.....dijak  
 .....ZAPUSTITI SE.....
- 54....voditelj.....1...2...3...4...5...6...7.....natečaj  
 .....USPETI.....
- 55....pulover.....1...2...3...4...5...6...7.....brat  
 .....RAZŠIRITI SE.....
- 56....župnik.....1...2...3...4...5...6...7.....vdovec  
 .....PRIKIMATI.....
- 57....krotilec.....1...2...3...4...5...6...7.....lev  
 .....PREŽIVETI.....
- 58....pravnik.....1...2...3...4...5...6...7.....zakon  
 .....UVELJAVITI SE.....
- 59....klovn.....1...2...3...4...5...6...7.....baritonist  
 .....ZAPETI.....
- 60....potapljač.....1...2...3...4...5...6...7.....zid  
 .....POSUŠITI SE.....
- 61....potok.....1...2...3...4...5...6...7.....Libijec  
 .....IZGINITI.....
- 62....Američan.....1...2...3...4...5...6...7.....aligator

- .....ODSKOČITI.....
- 63....vojak.....1...2...3...4...5...6...7.....marksist  
.....UITI.....
- 64....marsovec.....1...2...3...4...5...6...7.....dojenček  
.....POMODRETI.....
- 65....pilot.....1...2...3...4...5...6...7.....terorist  
.....ŽALOVATI.....
- 66....mesar.....1...2...3...4...5...6...7.....menih  
.....ZBLAZNETI.....
- 67....merjasec.....1...2...3...4...5...6...7.....vaščan  
.....POBESNETI.....
- 68....zidar.....1...2...3...4...5...6...7.....pes  
.....ZMRZOVATI.....
- 69....vandal.....1...2...3...4...5...6...7.....meščan  
.....ZBEŽATI.....
- 70....volivec.....1...2...3...4...5...6...7.....poslanec  
.....KRIČATI.....
- 71....mehanik.....1...2...3...4...5...6...7.....kirurg  
.....POSTAVLJATI SE.....
- 72....šef.....1...2...3...4...5...6...7.....kandidat  
.....OBUPATI.....
- 73....prodajalec.....1...2...3...4...5...6...7.....direktor  
.....JOKATI SE.....
- 74....Nemec.....1...2...3...4...5...6...7.....junak  
.....PLOSKATI.....
- 75....los.....1...2...3...4...5...6...7.....lopov  
.....USTAVITI SE.....
- 76....prijatelj.....1...2...3...4...5...6...7.....programer  
.....MAHATI.....
- 77....kip.....1...2...3...4...5...6...7.....Italijan  
.....PASTI.....

78.....minister.....1...2...3...4...5...6...7.....deček  
.....POTITI SE.....

79.....tiger.....1...2...3...4...5...6...7.....Anglež  
.....ŠEPATI.....

80.....uhan.....1...2...3...4...5...6...7.....prašič  
.....SMRDETI.....

Hvala lepa.

## APPENDIX C

### Experiment 1 materials

Shown in singular-singular condition only.

- (254) Direktor, ki ga je nadrl mlad prodajalec – JOKATI SE
- (255) Pevec, ki ga je poslušal nesrečen bolnik – ZBOLETI
- (256) Politik, ki ga je podkupil neusmiljen zločinec – PRIZNATI
- (257) Stric, ki ga je obiskal hrupen nečak – KLEPETATI
- (258) Učitelj, ki ga je popravil nadobuden učenec – ZMOTITI SE
- (259) Volk, ki ga je ujel prezebel vohun – POBEGNITI
- (260) Gledalec, ki ga je videl užaljen igralec – SKRIVATI SE
- (261) Hrt, ki ga je premamil živahen zajec – SKAKATI
- (262) Rak, ki ga je naročil močen Francoz – HODITI
- (263) Novinar, ki ga je spremljal priden študent – SPREMENITI SE
- (264) Ribič, ki ga je oplazil gladek losos – PLAVATI
- (265) Stol, ki ga je pobarval bolan kadilec – POBLEDETI
- (266) Sodnik, ki ga je okradel hladokrven morilec – GREŠITI
- (267) Tanker, ki ga je spremljal nizek čoln – RAZLETETI SE
- (268) Tat, ki ga je prepoznal vesel turist – SMEJATI SE
- (269) Skladatelj, ki ga je zdravil pameten zdravnik – ZAJTRKOVATI
- (270) Tujec, ki ga je zanimal neznan strup – POLITI SE
- (271) Plezalec, ki ga je povabil vnet organizator – NAPITI SE
- (272) Računalnik, ki ga je prodal redoljuben Avstrijec – DELATI

- (273) Konj, ki ga je presenetil oster ovinek – ZAVITI
- (274) Angel, ki ga je srečal strasten pijanec – GUGATI SE
- (275) Vitez, ki ga je začaral hudoben čarovnik – JEZITI SE
- (276) Medved, ki ga je napadel neveden gobar – UMRETI
- (277) Članek, ki ga je napisal nadarjen sodelavec – USPETI
- (278) Lovec, ki ga je gledal debel kmet – ORATI
- (279) Dedek, ki ga je treniral zagnan fant – TEČI
- (280) Smučar, ki ga je zadel majhen kamen – ODLETETI
- (281) Poslovnež, ki ga je prevzel visok nebotičnik – PROPADATI
- (282) Jastog, ki ga je pekel hiteč gasilec – ZAŽGATI SE
- (283) Slavist, ki ga je povabil znan raziskovalec – OBJAVLJATI
- (284) Lopov, ki ga je zavohal ranjen los - USTAVITI SE
- (285) Maneken, ki ga je uredil načimrn masker – ZEHATI
- (286) Lesar, ki ga je podrl strohnel kozolec – ZRUŠITI SE
- (287) Čevljar, ki ga je navdušil moderen čevelj – POPUSTITI
- (288) Maček, ki ga je prestrašil siv martinček – ODPLAZITI SE
- (289) Vrtnar, ki ga je navdahnil lep šopek– DIŠATI
- (290) Kolesar, ki ga je zbil drveč motor – PREVRNITI SE
- (291) Avtomobil, ki ga je prehitel bel tovornjak – RAZBITI SE
- (292) Motorist, ki ga je užalil prileten pešec – ODKORAKATI
- (293) Avion, ki ga je uničil rdeč vlak – PELJATI
- (294) Bik, ki ga je zabodel ponosen matador – RANITI SE
- (295) Profesor, ki ga je okaral neolikan natakár – ODITI
- (296) Sprehajalec, ki ga je butnil neroden kotalkar – OPOTEČI SE
- (297) Vdovec, ki ga je zadržal vesten župnik – PRIKIMATI
- (298) Lev, ki ga je bičal krut krotilec – PREŽIVETI
- (299) Zakon, ki ga je navedel ugleden pravnik – UVELJAVITI SE
- (300) Klovn, ki ga je poslušal zajeten baritonist – ZAPETI
- (301) Zid, ki ga je zmočil moker potapljač – POSUŠITI SE
- (302) Potok, ki ga je preplaval zbegán Libijec – IZGINITI
- (303) Aligator, ki ga je lovil velik Američan – ODSKOČITI

- (304) Marksist, ki ga je davil maskiran vojak – UITI
- (305) Marsovec, ki ga je zbudil lačen dojenček – POMODRETI
- (306) Menih, ki ga je zmerjal okrvavljen mesar – ZBLAZNETI
- (307) Merjasec, ki ga je sovražil razjarjen vaščan – POBESNETI
- (308) Zidar, ki ga je ugriznil stekel pes – ZMRZOVATI
- (309) Meščan, ki ga je brcal mladoleten vandal – ZBEŽATI
- (310) Mehanik, ki ga je priporočil slaven kirurg – POSTAVLJATI SE
- (311) Šef, ki ga je razočaral dober kandidat – OBUPATI
- (312) Programer, ki ga je opazil nasmejan prijatelj – POMAHATI
- (313) Italijan, ki ga je očaral izklesan kip – PASTI
- (314) Deček, ki ga je slekel pokvarjen minister – POTITI SE
- (315) Tiger, ki ga je zasledoval star Anglež – ŠEPATI
- (316) Uhan, ki ga je polizal umazan prašič – SMRDETI

## APPENDIX D

### Experiment 2 materials

Shown in dual-singular condition only.

- (317) Študentki zunaj dvorca – UPRETI SE
- (318) Sestrični škotskega vladarja – OVDOVETI
- (319) Pevki za poročni obred – VADITI
- (320) Gledalki na teniškem turnirju – KRIČATI
- (321) Raziskovalki z umetniškim darom – VZTRAJATI
- (322) Vodički maturantskega izleta – KLEPETATI
- (323) Vdovi s stanovanjskim skladom – ODPITATI
- (324) Glasbenici v nočnem lokalu – IMPROVIZIRATI
- (325) Tajnici za izobraževalni program – PRENEHATI
- (326) Političarki v skupščini – STRINJATI SE

- (327) Demonstrantki za ograjo – PREPEVATI
- (328) Športnici v reklamih – TECI
- (329) Ladji z vidno zastavo – PREDATI
- (330) Plezalki pod močno lučjo – PRITOŽEVATI SE
- (331) Snažilki v šoli – POSPRAVLJATI
- (332) Svetovalci za bogato firmo – ODITI
- (333) Vohunki iz tuje države – SPOTIKATI SE
- (334) Nudistki blizu peščine – SONCITI SE
- (335) Sodnika za preiskavo – RAZMIŠLJATI
- (336) Šoferja s kaznijo – SPREMENITI SE
- (337) Učenca z novo knjigo – IZBOLJŠATI SE
- (338) Igralca v nadaljevanju – RECITIRATI
- (339) Vratarja varnostne družbe – KARTATI
- (340) Tekmeca na dirki – ČAKATI
- (341) Direktorja dobrotelne ustanove – SLAVITI
- (342) Duhovnika iz podeske cerkve – MOLITI
- (343) Fotografista iz televizijske postaje – POHITETI

- (344) Gangsterja s hudim sovražnikom – IZGINITI
- (345) Predstavnika iz sindikata – GLASOVATI
- (346) Slona pri slapu – PASTI
- (347) Vojaka z lahkomišelnim poveljnikom – SPROSTITI SE
- (348) Mornarja z rešilnim jopičem – POPIVATI
- (349) Gasilca pred blokom – POČIVATI SE
- (350) Skavta v šotoru – PETI
- (351) Glasbenika z močnim ojačevalcem – POZIRATI
- (352) Turista s fotoaparatom – POSTAVITI SE

## APPENDIX E

### Experiment 3 and 4 materials

Shown in singular-singular condition only.

- (353) A manager whom a young salesman has told off – CRYING
- (354) A singer to whom an unfortunate patient was listening – ILL
- (355) A politician whom a pitiless convict is bribing – CONFESSING
- (356) An uncle whom a noisy nephew was visiting – CHATTERING
- (357) A teacher whom a promising pupil has corrected – INCORRECT
- (358) A wolf which a frozen spy has caught – ESCAPING
- (359) A spectator whom an offended actor has spotted – HIDING
- (360) A greyhound which a lively rabbit was tempting – JUMPING
- (361) A crab which a plump Frenchman was ordering – WALKING
- (362) A journalist whom a good student was accompanying – ADAPTING
- (363) A fisherman whom a smooth sardine has brushed – SWIMMING
- (364) A chair which a sickly smoker was painting – PALE
- (365) A judge whom a cold-blooded murderer has robbed – IMMORAL
- (366) A tanker which a low boat was following – EXPLODING
- (367) A thief whom a merry tourist has met – LAUGHING
- (368) A composer whom a clever doctor has cured – HUNGRY
- (369) A foreigner whom an unknown poison has interested – SPLASHING
- (370) A climber whom an eager organiser has invited – BOOZING
- (371) A computer which a tidy Austrian was selling – WORKING

- (372) A horse which a sharp corner has surprised – TURNING
- (373) An angel whom a confirmed drunk has run into – SWAYING
- (374) A knight whom an evil wizard has bewitched – ANGRY
- (375) A bear which an ignorant milkmaid has provoked – DYING
- (376) An article which a gifted colleague has written – SUCCESSFUL
- (377) A hunter whom a fat farmer was watching – PLOUGHING
- (378) A grandfather whom an eager boy was coaching – RUNNING
- (379) A skier whom a small stone has hit – HURLING
- (380) A businessman whom a tall skyscraper has impressed – CRUMBLING
- (381) A lobster which a hasty firemen was cooking – BURNING
- (382) A linguist whom a well-known researcher has invited – PUBLISHING
- (383) A burglar whom an injured elk has scented – STOPPING
- (384) A model whom a vain beautician has made up – YAWNING
- (385) A carpenter whom a rotten barn has knocked over – COLLAPSING
- (386) A cobbler whom a modern shoe has satisfied – FALLING APART
- (387) A cat which a grey lizard has startled – SLITHERING
- (388) A gardener whom a beautiful bouquet has inspired – FRAGRANT
- (389) A cyclist whom a rushing motorbike is hitting – OVERTURNING
- (390) A car which a white lorry has overtaken – rusty
- (391) A biker whom an elderly pedestrian has offended – WALKING OFF
- (392) A plane which a red train has overtaken – DECELERATING
- (393) A bull which a proud matador has skewered – DISABLED
- (394) A professor whom an uncouth waiter was criticising – RESIGNING
- (395) A walker whom a clumsy rollerblader has knocked – TOPPLING
- (396) A widower whom a conscientious priest is detaining – NODDING
- (397) A lion which a cruel lion tamer is whipping – ALIVE
- (398) A law which a reputable lawyer is citing – UNQUESTIONABLE
- (399) A clown whom a substantial baritone was watching – ZAPETI
- (400) A wall which a damp diver has wet – DRYING
- (401) A stream which a confused Libyan has swum across – DISAPPEARING
- (402) An alligator which a big American is hunting – FLINCHING

- (403) A Marxist whom a masked soldier was strangling – ABSCONDING
- (404) A Martian whom a hungry baby has awoken – BLUE
- (405) A monk whom a bloody butcher is blaming – IRATE
- (406) A wild boar which an angry villager hates – FLEEING
- (407) A bricklayer whom a rabid dog has bitten – FREEZING
- (408) A resident whom an underage vandal was kicking – RUNNING AWAY
- (409) A mechanic whom a famous surgeon has recommended – BOASTFUL
- (410) A boss whom a good candidate has disappointed – DESPERATE
- (411) A programmer whom a smiling friend has spotted – WAVING
- (412) An Italian whom a chiselled sculpture has charmed – FALLING
- (413) A boy whom a perverted minister is undressing – SWEATY
- (414) A tiger which an old Englishman was trailing – LIMPING
- (415) A ring which a dirty pig is licking – SMELLY

## APPENDIX F

### Experiment 5 materials

Shown in the neuter-neuter condition only.

#### F.1 Human

- (416) VSTATI Truplo, ki ga je počistilo otroče  
GET UP A corpse which a child was cleaning
- (417) ZASPATI Dojenče, ki ga je obleklo ženšče  
FALL ASPLEEP An infant whom an old woman was dressing
- (418) ZBUDITI SE. Dete, ki ga je prestrašilo grozno bitje  
AWAKEN A baby whom an evil corpse bewitched
- (419) RAZTRGATI SE Spričevalo, ki ga je dobilo godrnjalo  
TEAR A report which a grumbler received
- (420) DOZORETI Grozdje, ki ga je videlo radovedno detece  
RIPEN Grapes which a curious infant saw
- (421) ZAGUGATI SE Strašilo, ki ga je objelo detece  
SWAY A scarecrow which a child hugged
- (422) POMODRETI Stegno, ki ga je sunilo lačno otroče  
TURN BLUE A thigh which a hungry baby kicked

- (423) KRIČATI Čvekaló, ki ga je bolelo črevo  
CRY OUT A blabberer whose bladder was hurting
- (424) SMEJATI SE Revše, ki ga je prepoznalo veselo klepetalo  
LAUGH A wretch whom a merry chatterbox recognised
- (425) TOPITI SE Vedro, ki ga je pozabilo ženšče  
MELT A bucket which an old woman forgot
- (426) ZASVETITI Svetilo, ki ga je prižgalo radovedno ženšče  
LIGHT A candle which a curious big-nose lit
- (427) PRITOŽEVATI SE Zijalo, ki ga je ostriglo klepetalo  
COMPLAIN An old woman whom a chatterbox haircutted
- (428) PEČI Olje, ki ga je popilo detece  
BURN Oil which a child drank
- (429) RAZPASTI Pokrivalo, ki ga je nosilo teslo  
FALL APART A headgear which a scarecrow wore
- (430) USTAVITI SE Jezikalo, ki ga je zavohalo ranjeno kljuse  
GET UP A chatterbox whom an injured nag scented
- (431) POBLEDETI Naslonjalo, ki ga je pobarvalo bolno dekletce  
PALE A stool which a poorly little girl painted
- (432) ZMOČITI SE Dete, ki ga je očaralo kopališče  
GET WET An infant that a swimming pool charmed
- (433) ZAJOKATI Dojenče, ki ga je ustrašilo sekalo  
CRY A baby which an axe frightened
- (434) RAZBITI SE Steklo, ki ga je vzelo teslo  
BREAK Glass which a lout took

- (435) PRIDITI Jajce, ki ga je naročilo klepetalo  
COME Egg which a chatterbox ordered
- (436) USMRADITI SE Zelje, ki ga je pojedlo dekletce  
GO OFF Cabbage which a girl ate
- (437) SPEČI SE Meso, ki ga je peklo teslo  
BURN Meat which a lout was cooking
- (438) NAPITI SE Čvekalo, ki ga je povabilo umazane  
GET DRUNK A blabberer whom a sloven invited
- (439) OZELENETI Brdo, ki ga je ustvarilo božanstvo  
GO GREEN A hillock which a god created
- (440) JESTI Revše, ki ga je mikalo pleče  
EAT A wretch whom ham tempted
- (441) SPREMENITI SE Ime, ki ga je napisalo dekletce  
CHANGE A name which a little girl wrote down
- (442) ZDRZNITI SE Žrebe, ki ga je opazilo umazane  
WINCE A foal whom a chatterbox noticed
- (443) POLITI SE Olje, ki ga je prodalo gobezdalo  
SPILL Oil which a sloven was selling
- (444) ŠEPATI Zijalo, ki ga je zasledovalo siročče  
LIMP A bignose which an orphan was following
- (445) KONČATI SE Tekmovanje, ki ga je izgubilo budalo  
FINISH A competition which a poor idiot lost
- (446) OBUPATI Dete, ki ga je razočaralo darilo  
DESPAIR A child which a present disappointed

- (447) ODPRETI SE Gledališče, ki ga je obiskalo gobezdalo  
CLOSE A theatre which an audience visited
- (448) ZASMRDETI Kopje, ki ga je polizalo umazane  
SMELL A spear which a dirty person licked
- (449) POČRNETI Srebro, ki ga je ukradlo budalo  
GET LOST Silver which an idiot stole
- (450) POČITI Okno, ki ga je očistilo pridno dekle  
BREAK A window pane which a good girl was cleaning
- (451) ZRUŠITI SE Strašilo, ki ga je postavilo budalo  
FALL DOWN A scarecrow which an idiot put up
- (452) PREKINITI SE Predavanje, ki ga je motilo blebetalo  
STOP A lecture which a bigmouth interrupted
- (453) POPLAVITI Posestvo, ki ga je podedovalo gobezdalo  
FLOOD Land which a chatterer
- (454) ZBOLETI Čvekalo, ki ga je poslušalo nesrečno bitje  
FALL ILL A blabberer that a hapless creature was listening to
- (455) ZATRESTI Brdo, ki ga je preplezalo godrnjalo  
TREMBLE A hill which a grumbler climbed
- (456) ZAJOKATI Revše, ki ga je nadrlo razvajeno dekle  
CRY A wretch whom a spoilt only child told off
- (457) KLEPETATI Zijalo, ki ga je obiskalo hrupno blebetalo  
CHATTER A big-nose whom a noisy chatterbox was visiting
- (458) ZLOMITI SE Jadro, ki ga je popravilo godrnjalo  
BREAK A sail which a grumbler repaired

(459) OHRABROVATI Navdušenje, ki ga je pokazalo otroče

INSPIRE COURAGE A rush which a girl showed

(460) ZASPATI Jezikalo, ki ga je premamilo lepo ležišče

FALL ASLEEP A chatterbox whom a beautiful bed / couch entranced

(461) UMRETI Žrebe, ki ga je napadlo nevedno dekle

DIE A foal which a girl attacked

## F.2 Collectives

(462) UČINKOVATI Cepljenje, ki ga je priporočilo novo zdravilišče

GO UP IN PRICE / TAKE EFFECT A vaccination which a new hospital recommended

(463) POBESNETI Divje prase, ki ga je sovražilo moštvo

GO MAD A wild piglet which a crew hated

(464) ZAŽIVETI Svetišče, ki ga je podpiralo socialno skrbstvo

SURVIVE A temple which a social welfare supported

(465) ODPOVEDOVATI SE Potovanje, ki ga je prepovedalo ministrstvo

GET CANCELLED A voyage which a ministry banned

(466) ZORETI Jabolko, ki ga je gnojilo društvo

RIPEN An apple which an association / a public manured

(467) UVELJAVITI SE Določilo, ki ga je sprejelo sodstvo

WIN RECOGNITION An act which a ministry judicature adopted

(468) ZARJAVETI Orožje, ki ga je prodalo podjetje

HUM A string instrument which a company sold

(469) ZMEČKATI SE Perilo, ki ga je izbralo društvo

CREASE The laundry which a population chose

- (470) UVELJAVITI SE Dejanje, ki ga je predlagalo ministrstvo  
WIN RECOGNITION An action which a ministry suggested
- (471) UVELJAVITI SE Milo, ki ga je izvozilo novo podjetje  
WORK OUT A soap which a new company exported
- (472) ZBOSTI Želo, ki ga je našlo biološko društvo  
PRICK A sting which a biology society found
- (473) NADALJEVATI SE Hudodelstvo, ki ga je obsodilo zborovanje  
PROCEED A crime which a gathering condemned
- (474) PODRAŽITI SE Gorivo, ki ga je uporabljalo novo podjetje  
GO UP IN PRICE Fuel which a new company uses
- (475) DUŠITI SE Prebivalstvo, ki ga je navdušilo lepo drevo  
SUFFOCATE An population which a beautiful tree has inspired
- (476) ZAČETI SE Tekmovanje, ki ga je priredilo uredništvo  
BEGIN A competition which an editorship organised
- (477) OBNESTI SE Pohištvo, ki ga je izbralo ladjevje  
TO BE EFFECTIVE A furniture which a fleet chose
- (478) KONČATI SE Kaznovanje, ki ga je preživelo celo plemo  
END A punishment which a whole tribe suffered
- (479) SKAKATI Krdelo, ki ga je videlo živahno jagnje  
JUMP A pack which a lively lamb saw
- (480) USPETI Jurišanje, ki ga je organiziralo brodovje  
SUCCEED An attack which a fleet organised
- (481) ZAŽGATI SE Pecivo, ki ga je speklo sorodstvo  
GET BURNT A pastry which a family baked

- (482) ODPASTI Praznovanje, ki ga je organiziralo celo mesto  
BE CANCELLED A celebration which the whole town organised
- (483) PORUMENETI Berilo, ki ga je kupilo bralstvo  
YELLOW A reading book which a readership bought
- (484) OSUPNITI Prebivalstvo, ki ga je očaralo izklesano delo  
BE AMAZED A population which a chiselled sculpture charmed
- (485) USPETI Anketiranje, ki ga je delalo celo sorodstvo  
SUCCEED A questionnaire which a whole clan filled in
- (486) KONČATI SE Naključje, ki ga je opazilo moštvo  
An event, accident which a crew caused
- (487) UTIHNITI Hrumenje, ki ga je poslušalo nesrečno občinstvo  
GO SILENT A boom that a hapless audience was listening to
- (488) ZASTARETI Pismo, ki ga je bralo bralstvo  
BECOME OBSOLETE A letter that a readership read

### F.3 Normal

- (489) PELJATI SE Kolo, ki ga je prehitelo skiro  
DRIVE / MOVE A bike which a scooter overtook
- (490) ZBLEDETI Znamenje, ki ga je imelo pisalo  
PALE A symbol which a pen had
- (491) ZGODITI SE Mučenje, ki ga je preprečilo izsiljevanje  
HAPPEN Torture which blackmail prevented
- (492) IZGINJATI Bogastvo, ki ga je nakopičilo kraljestvo  
DISSIPATE Wealth which a kingdom amassed

- (493) ODZVENETI Petje, ki ga je spremljalo godalo  
RING OUT Singing which a string instrument enlivened
- (494) IZGINITI Kosilo, ki ga je zakrilo kadilo  
DISAPPEAR A lunch which incense covered
- (495) POKVARITI SE Mleko, ki ga je prevrnilo korenje  
GET SPOILT The milk which a carrot knocked over
- (496) PREKUCNITI Oko, ki ga je poškodovalo drveče vozilo  
FLIP OVER An eye which a rushing vehicle damaged
- (497) PROPASTI Posestvo, ki ga je zasedlo napadalno kljuse  
FALL INTO RUINS A farm which a pushy calf took over
- (498) NARASTI Kesanje, ki ga je povzročilo kastriranje  
INCREASE A regret which castration caused
- (499) STOPNJEVATI SE Razpoloženje, ki ga je prekinilo grmenje  
INTENSIFY The atmosphere which the thunder interrupted
- (500) ZASTOKATI Deblo, ki ga je zrušilo neurje  
MOAN A tree which a storm felled
- (501) ZAVITI Žrebe, ki ga je presenetilo križišče  
VEER OFF A foal which a crossroads suprised
- (502) ZRASTI Tele, ki ga je zabodlo ostro dleto  
GROW A calf which a sharp chisel pricked
- (503) PROPASTI Krilo, ki ga je umazalo črnilo  
FALL APART A skirt which mud / bleach / dye dirtied
- (504) SMRDETI Prase, ki ga je premamilo sveže gnojilo  
STINK A piglet which fresh manure tempted

- (505) ODLOMITI SE Držalo, ki ga je imelo sekalo  
BREAK A handle which a chopper had
- (506) POTOPITI SE Jadro, ki ga je prevrnilo neurje  
SINK A sail which a storm struck
- (507) TROHNETI Truplo, ki ga je prekrivalo resje  
ROT A corpse which heather hid
- (508) ZAMAJATI SE Stojalo, ki ga je prevrnilo nerodno kljuse  
SHAKE A stand which a clumsy nag knocked over
- (509) PODRETI SE Svetišče, ki ga je poškodovalo neurje  
COLLAPSE A temple which a storm damaged
- (510) KLITI Žito, ki ga je jedlo pišče  
JUMP AWAY A chick which grain tempted
- (511) USTAVITI SE Kolo, ki ga je dohitelo belo vozilo  
STOP A motorbike which a white vehicle overtook
- (512) KRVAVETI Čelo, ki ga je ranilo bodalo  
BLEED A brow which a dagger cut
- (513) PREMAKNITI SE Ogledalo, ki ga je gledalo ščene  
MOVE A mirror which a dog looked at
- (514) DELOVATI Srce, ki ga je uničilo mamilo  
WORK A heart which a drug / liquor destroyed
- (515) POSUŠITI SE Polje, ki ga je izpodrinlo bukovje  
DRY A field which a beech wood took over
- (516) PODRAŽITI SE Jabolko, ki ga je pokrivalo barvasto platno  
GO UP IN PRICE An apple which a coloured parachute covered

- (517) ODLETETI Letalo, ki ga je gledalo pišče  
FLY OFF A chick which a new plane scared
- (518) PASTI Deblo, ki ga je razdelilo sekalo  
FALL A tree which an axe split
- (519) USTAVITI SE Tele, ki ga je prestrašilo vozilo  
STOP An calf that a vehicle frightened
- (520) POZDRAVITI SE Krilo, ki ga je poškodovalo pišče  
GET BETTER A wing which a chick has injured
- (521) PORJAVETI Rešeto, ki ga je obrizgalo vino  
GO BROWN A sieve which wine splashed
- (522) ODMRETI Grmovje, ki ga je zakrivalo drevo  
GO GREEN / WITHER A shrub which a tree hid
- (523) SESEDATI SE Kopno, ki ga je obplulo nizko plovilo  
ERODE A land which a low vessel was following
- (524) RAZTRGATI SE Padalo, ki ga je žvečilo ščene  
TEAR A parachute which a doggie chewed
- (525) PROPADATI Dno, ki ga je sestavljalo blato  
CRUMBLE The ground which was composed of mud
- (526) PRESAHNITI Jezero, ki ga je preplavalo zbegano jagnje  
DRY UP A lake which a confused idiot swam across
- (527) ZRUŠITI SE Poslopje, ki ga je prekrivalo ivje  
COLLAPSE An edifice which frost covered
- (528) JESTI Prase, ki ga je zanimalo drevo  
EAT A piglet which a tree interested

- (529) ZAUDARJATI Truplo, ki ga je odkrilo ščene  
STINK A corpse which a doggie uncovered
- (530) POTEČI Zavarovanje, ki ga je pokrilo zlato  
RUN OUT An insurance which gold covered
- (531) SPLAHNETI Čustvo, ki ga je izzvalo vedenje  
DECREASE The feeling which a relationship provoked
- (532) PRENEHATI Vnetje, ki ga je nakazalo razdraženo žrelo  
STOP An inflammation which a hot brow showed
- (533) POSLABŠATI Črkovanje, ki ga je izboljšalo izobraževanje  
WORSEN A spelling which an education improved
- (534) IZGINITI Oblikovanje, ki ga je imelo platno  
DISAPPEAR A shape / texture which linen had
- (535) PREMAKNITI SE Poleno, ki ga je pohodilo jagnje  
MOVE OUT THE WAY A log which a lamb trod on
- (536) ZMRZNITI Barje, ki ga je prekrivalo ivje  
FREEZE A marsh / field which frost covered
- (537) ZATEMNITI SE Nebo, ki ga je polepšalo sonce  
DARKEN The scenery which the moon beautified
- (538) POSUŠITI SE Oblačilo, ki ga je namočilo rosenje  
DRY A garment which a sprinkler / dew wet
- (539) URESNIČITI SE Sanjarjenje, ki ga je sprožilo stanovanje  
COME TRUE A dream which a flat inspired
- (540) RAZCVETETI SE Grmovje, ki ga je reklamiralo glasilo  
BLOOM A bush which an advert advertised

(541) PLAVATI Dovoljenje, ki ga je oplazilo morsko šilo

SWIM / SINK A permit which a pipefish has swum by

(542) ODPLAZITI SE Tele, ki ga je prestrašilo luskavo bitje

CREEP OFF A calf which a scaly being startled

## APPENDIX G

### Experiment 6 materials

Shown in singular-singular condition only.

(543) Mehanik ali brat

A mechanic or his brother

(544) Gradbenik ali tesar

A builder or a carpenter

(545) Razstava ali predstava

An exhibition or a show

(546) Violinist ali kitarist

A violinist or a guitarist

(547) Psiholog ali zdravnik

A psychologist or a doctor

(548) Paprika ali bučka

A pepper or a courgette

(549) Oče ali stric

Father or uncle

(550) Tajnica ali šefinja

The secretary or the boss

(551) Dijak ali sošolec

A pupil or his classmate

(552) Vizitka ali listnica

A business card or a wallet

(553) Rak ali jastog

A crab or a lobster

(554) Računalnik ali fotokopirni stroj

A computer or a photocopier

(555) Vojak ali mornar

A soldier or a sailor

(556) Pomaranča ali grenivka

An orange or a grapefruit

(557) Igrača ali lutka

A toy or a doll

(558) Najstnica ali sestra

A teenager or her sister

## APPENDIX H

### Experiment 7 materials

Shown in singular-singular condition only.

(559) Kirurg in brat

A surgeon and his brother

(560) Najstnica in sestra

A teenager and her sister

(561) Tajnica in šefinja

The secretary and the boss

(562) Gradbenik in tesar

A builder and a carpenter

(563) Trgovka in stranka

A shop assistant and a customer

(564) Vojak in mornar

A soldier and a sailor

(565) Vizitka in kartica

A business card and a (credit) card

(566) Psiholog in zdravnik

A psychologist and a doctor

(567) Razstava in predstava

An exhibition and a show

(568) Računalnik in tiskalnik

A computer and a printer

(569) Pomaranča in grenivka

An orange and a grapefruit

(570) Rak in jastog

A crab and a lobster

(571) Dijak in sošolec

A pupil and his classmate

(572) Kasetna in plošča

A tape and a record

(573) Električar in klepar

An electrician and a plumber

(574) Paprika in bučka

A pepper and a courgette

(575) Duhovnik in menih

A priest and a monk

(576) Kobilica in krava

A mare and a cow

(577) Časopis in učbenik

A newspaper and a textbook

(578) Tovarnjak in vlak

A lorry and a train

(579) Kuharica in fotografinja

A cook and a photographer

(580) Klobuk in šal

A hat and a scarf

(581) Novinarka in natararica

A journalist and a waitress

(582) Policist in pešec

A policeman and a pedestrian

(583) Primorka in Ljubljančanka

A Primorskan and a Ljuljanan

(584) Hotel in blok

A hotel and a tower block

(585) Hiša in cerkev

A house and a church

(586) Kolesarka in motoristka

A cyclist and a biker

(587) Svinčnik in zvezek

A pencil and an exercise book

(588) Knjižnicarke in vrtnarica

A librarian and a gardener

(589) Igrača in lutka

A toy and a doll

(590) Bonbon in piškot

A sweet and a biscuit

## APPENDIX I

### Experiment 8 materials

Shown in masculine-masculine condition only.

(591) Deček in bratranec

a boy and his cousin

(592) Profesor in učenec

A teacher and a pupil

(593) Študent in predavatelj

A student and lecturer

(594) Bolničar in bolnik

A nurse and a patient

(595) Pevec in poslušalec

A singer and a listener

(596) Gospod in strežaj

Master and servant

(597) Pisatelj in urednik

A writer and an editor

(598) Zapornik in ječar

A prisoner and a gaoler

(599) Igralec in gasilec

An actor and a fireman

(600) Moški in kolega

A man and his colleague

(601) Zavarovanec in dedek

An insured person and his grandfather

(602) Vlačugar in krojač

A pimp and a tailor

(603) Varovanec in skrbnik

A ward and a guardian

(604) Lastnik in maček

An owner and his cat

(605) Jaguar in volk

A jaguar and a wolf

(606) Konj in prašič

A horse and a pig

(607) Sokel in voluhar

An owl and a vole

(608) Gliser in čoln

A glider and a boat

(609) Travnik in gozd

A lawn and a wood

(610) Predalnik in stol

A chest of drawers and a chair

(611) Brokoli in krompir

Broccoli and potato

(612) Televizor in čaj

A television and a tea

(613) Nogomet in rokomet

Football and handball

(614) Krožnik in lonec

A plate and a pot

(615) Macesen in bor

A larch and a pine

(616) Mož in zaročenec

A husband and a fiancé

(617) Slovar in časopis

A dictionary and a newspaper

(618) Bencin in butan

Petrol and gas

(619) Kraljevič in sin

A king and his son

(620) Violinist in kitarist

A violinist and a guitarist

(621) Kadilec in pijanec

A smoker and a drinker

(622) Oče in stric

A father and an uncle

## APPENDIX J

### Experiment 9 materials

Shown in masculine-masculine condition only.

(623) Deček in bratranec

a boy and his cousin

(624) Profesor in učenec

A teacher and a pupil

(625) Študent in predavatelj

A student and lecturer

(626) Bolničar in bolnik

A nurse and a patient

(627) Pevec in poslušalec

A singer and a listener

(628) Gospod in strežaj

Master and servant

(629) Pisatelj in urednik

A writer and an editor

(630) Zapornik in ječar

A prisoner and a gaoler

(631) Igralec in gasilec

An actor and a fireman

(632) Moški in kolega

A man and his colleague

(633) Policist in prijatelj

A policeman and his friend

(634) Zavarovanec in dedek

An insured person and his grandfather

(635) Vlačugar in viski

A pimp and whiskey

(636) Varovanec in skrbnik

A ward and a guardian

(637) Lastnik in maček

An owner and his cat

(638) Krojač in vzorec

A tailor and a pattern

(639) Menih in samostan

A monk and a monastery

(640) Jaguar in volk

A jaguar and a wolf

(641) Sokel in voluhar

An owl and a vole

(642) Hrib in kozel

A hill and a goat

(643) Otoček in čoln

An island and a boat

(644) Travnik in gozd

A lawn and a wood

(645) Predalnik in stol

A chest of drawers and a chair

(646) Brokoli in krompir

Broccoli and potato

(647) Televizor in čaj

A television and a tea

(648) Nogomet in rokomet

Football and handball

(649) Zajtrk in spanec

Breakfast and a nap

(650) Macesen in bor

A larch and a pine

(651) Mož in zaročenec

A husband and a fiancé

(652) Tiskalnik in brusilnik

A printer and a grinder

(653) Bencin in butan

Petrol and gas

(654) Kraljevič in sin

A king and his son

## APPENDIX K

### Groza in strah details

The noted linguistic example of furthest-conjunct agreement, *groza in strah*, was examined in more detail through a Google search. The opposite order *strah in groza* is actually more common (210 hits with Google compared to 201 for *groza in strah*), notwithstanding the references to Corbett's example, which are included in the count. In fact, *Strah in groza v Las Vegasu* 'Fear and Loathing in Las Vegas' is the title of a popular novel and film.

Google produces only a few hits for *groza in strah* with a verbal predicate<sup>1:2</sup>

- (655) in groza in strah sta na velikem platnu videti še bolj  
and horror.F and fear.M be.DU on big screen see even more  
grozna in strašnejša  
horrible.M.DU and fearful.M.DU  
'And horror and fear on the big screen seem even more horrible and fear-  
ful'
- (656) niste slišali, da se je groza in strah  
NEG.AUX.2PL hear.PPL.M.PL that REF AUX.SG horror.F and fear.M  
pojavil pri ljudeh z vašim prihodom, imenovano svoboda  
appear.M.SG at people with your arrival.M called.N freedom.F  
'Have you not heard that horror and fear arose in people at your arrival  
which was called freedom?'

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<sup>1</sup>Of which, Examples 660 and 661 come from the same document, a story by Jakob Sket entitled *Miklova Zala: Povest iz turških časov*.

<sup>2</sup>Presented in order of popularity.

- (657) velike začudene otroške oči se zazro vame, v  
 big.F.PL amazed.F.PL infant.F.PL eyes.F.PL REF perceive.N.SG to.me in  
 njih gnezdita groza in strah  
 them.PL nest.DU horror.F and fear.M  
 'Big amazed infant eyes turn on me, and in them nest horror and fear'
- (658) se sploh ne zavedajo, da takšna groza in strah sploh  
 REF at.all NEG realise.PL that such.F.SG horror.F and fear.M at.all  
 obstajata  
 exist.DU  
 'They don't even realise that such horror and fear exist at all'
- (659) izkustvo erotizma povezuje izpolnitev želje s  
 experience eroticism.GEN link.SG fulfillment desire.GEN with  
 primarno eksistenčno grozo, groza in strah pa sta  
 primordial existential horror horror.F and fear.M however be.DU  
 posledici prepovedi ob smrti žrtve  
 consequence.DU on death victim.GEN  
 'Experience of eroticism links fulfillment of desire with primordial existential horror, horror and fear, then, are consequences of the prohibition of the death of the victim'
- (660) Zalo in Almiro obide groza in strah  
 Zala.ACC and Almira.ACC bypass.SG horror.F and fear.M  
 'Horror and fear bypass Zala and Almira'
- (661) Mirka spreleti groza in strah  
 Mirko.ACC flash-through.SG horror.F and fear.M  
 'Mirko shuddered with horror and fear'
- (662) groza in strah, je bila reakcija med NVO  
 horror.F and fear.M AUX.SG be.F reaction.F amongst NVO  
 "'Horror and fear" was the reaction at NVO'

There were four dual (ungendered) and four singular verbal predicates. Of the latter, two were present tense and therefore did not show gender agreement, one was masculine (nearest-conjunct agreement) and one feminine (possibly furthest-conjunct agreement, although it is likely to be agreement with noun predicate - Example 662)<sup>3</sup>.

<sup>3</sup>The predicate adjectives *grozna* and *strašnejša* (Example 655) have agreement which is ambiguous between masculine dual, feminine singular, and neuter plural, thus although I assume resolved agreement because that is clearly what is shown on the main verb, they could also be showing furthest-conjunct agreement. The premodifying adjective *takšna* (Example 658) has agreement which is ambiguous between masculine dual, feminine singular, and neuter plural,

The phrase the other way round also generates few (though slightly more) verbal predicates<sup>4</sup>:

- (663) Mongolska strah in groza vršita v Maribor DUAL
- (664) Strah in groza vas obhajata ob misli, da hočemo odpraviti privatno lastnino DUAL
- (665) Ljudje ne morejo spati, saj jim strah in groza lezeta do kosti DUAL
- (666) Strah in groza bodi pred vami vse živali vse živali na zemlji, vse ptice pod nebom, vse, kar mrgoli na zemeljskih tleh in ... SING
- (667) Navzoče spreletita strah in groza DUAL
- (668) Strah in groza je obšla Mirkove tovariše FEM SING
- (669) Strah in groza jih torej obide SING
- (670) Strah in groza ga je obdajala pred njo FEM SING
- (671) da je človek pred poslednjo sodbo skrusen, ničev, prevzema ga strah in groza SING
- (672) Ampak a ni tko, da njih strah in groza rajcata? DUAL
- (673) Dva zaljubljenca si izmenjata srebrna ringa, prstana, po čemer sledi strah in groza vseh mladih zaročencev SING
- (674) Prvi strah in groza sta zbledela, vendar se še živo spominjam, kako mi je bilo hudo. DUAL MASC

Six dual verbal predicates of which one is masculine (resolved agreement) and six singular of which two are feminine (nearest-conjunct agreement).

Overall, there is clearly little motivation from the texts found on Google to support the claim that even this one collocated phrase is associated with furthest-conjunct agreement on a widespread basis.

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thus although I assume feminine singular (nearest conjunct) agreement, analogous to the less ambiguous masculine singular agreement of *prvi* in 674, it could also be showing dual (resolved) agreement.

<sup>4</sup>Of which, Examples 667 to 670 come from the same document as before, *Miklova Zala: Povest iz turških časov*.

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