Lexical Processing in Monolinguals and Bilinguals

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DECLARATION

The work presented in this thesis has been composed by the candidate, Antonina Scarnà, under the supervision of Professor Andrew Ellis. The work has not been submitted in any previous application for a degree.

The data reported in Chapter 3 have been submitted for publication as the following paper:
Lexemes, not lemmas are the source of age of acquisition effects in lexical retrieval: Evidence from gender categorization and picture naming in Italian
(*Journal of Memory and Language*)

The data reported in Chapter 7 have been submitted submitted for publication as the following paper:
Access to grammatical gender (lemmas) and phonology (lexemes) in aphasia: the need for on-line measures
(Cognitive Neuropsychology)

All quotations have been distinguished by quotation marks and all sources of information have been acknowledged.

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Abstract

This thesis is about lexical processing in monolingual and bilingual speakers of English and Italian. It incorporates a mixture of cognitive experimental work and neuropsychology. Chapter 1 reviews the literature on monolingual lexical retrieval. In Chapter 2 groups of native English and Italian speakers name objects or read aloud their written names. Picture naming reaction times are affected by age of acquisition in English and AoA and name agreement in Italian. Word reading RTs are affected by AoA, frequency, orthographic neighbours and length in English and AoA, frequency and length in Italian. In Chapter 3 Italian speakers classify pictures by gender. Multiple regression analyses show effects of grammatical gender, gender agreement and name agreement but no effects of AoA. A factorial design experiment using matched sets of masculine and feminine, early or late acquired objects shows AoA to affect naming but not categorisation speed.

Chapter 4 is a second literature review on bilingualism and in Chapter 5 bilingual participants engage in naming items with cognate and non-cognate names matched on several variables. Bilinguals name cognates faster than non-cognates and take longer than monolinguals to name non-cognates. This is explored further in repetition priming experiments. Pictures with cognate names are named significantly faster than non-cognate ones, pictures are named significantly faster in English than Italian; same-language priming is faster than cross-language priming which is faster than naming unprimed pictures.

Chapter 6 is a final literature review on the cognitive neuropsychology of bilngualism. Chapter 7 discusses the importance of implicit testing, reporting word-finding problems and examining gender retrieval in a bilingual aphasic. Chapter 8 provides a discussion and overview.

Chapter 1

Organisation of Lexical Processing in English and Italian Monolinguals

1.1. Introduction to the Thesis

This thesis is about object naming and word production in speakers of English and Italian. It explores lexical processing in monolingual and bilingual speakers of both languages, starting with the factors involved in naming objects and words before proceeding to examine the production of grammatical gender in Italian native speakers. A further issue explored is that of lexical production in English-Italian bilinguals, especially with regards to cognate and non-cognate words and the technique of repetition priming. This thesis also includes a section of neuropsychological work in the form of a patient case report. The literature review in the thesis has been divided into three to reflect its three main areas of investigation. The present chapter reviews normal, monolingual lexical processing in English and Italian, Chapter 4 contains a second literature review on bilingual word processing and lastly, a short literature review on the neuropsychology of bilingualism is contained in Chapter 6.

1.2. Theories of Monolingual Lexical Retrieval

Cognitive modelling of monolingual lexical retrieval has a long history but it has only been relatively recently that psychologists (e.g. de Bot, 1992; Grainger & Dijkstra, 1992) have extended these models to account for the plausible organisation of the two languages of the bilingual. Before investigating the various configurations proposed in bilingual word production, it is essential to take into account the processes involved monolingually, by examining a number of models in existence.

1.3. Naming in English

1.3.1. Theoretical Models:

Patterson and Shewell (1987) and Similarities to Morton's (1969) Logogen Model

<u>Figure 1.1.</u> Cross-Modality Model of Single-Word Processing (Patterson & Shewell, 1987)

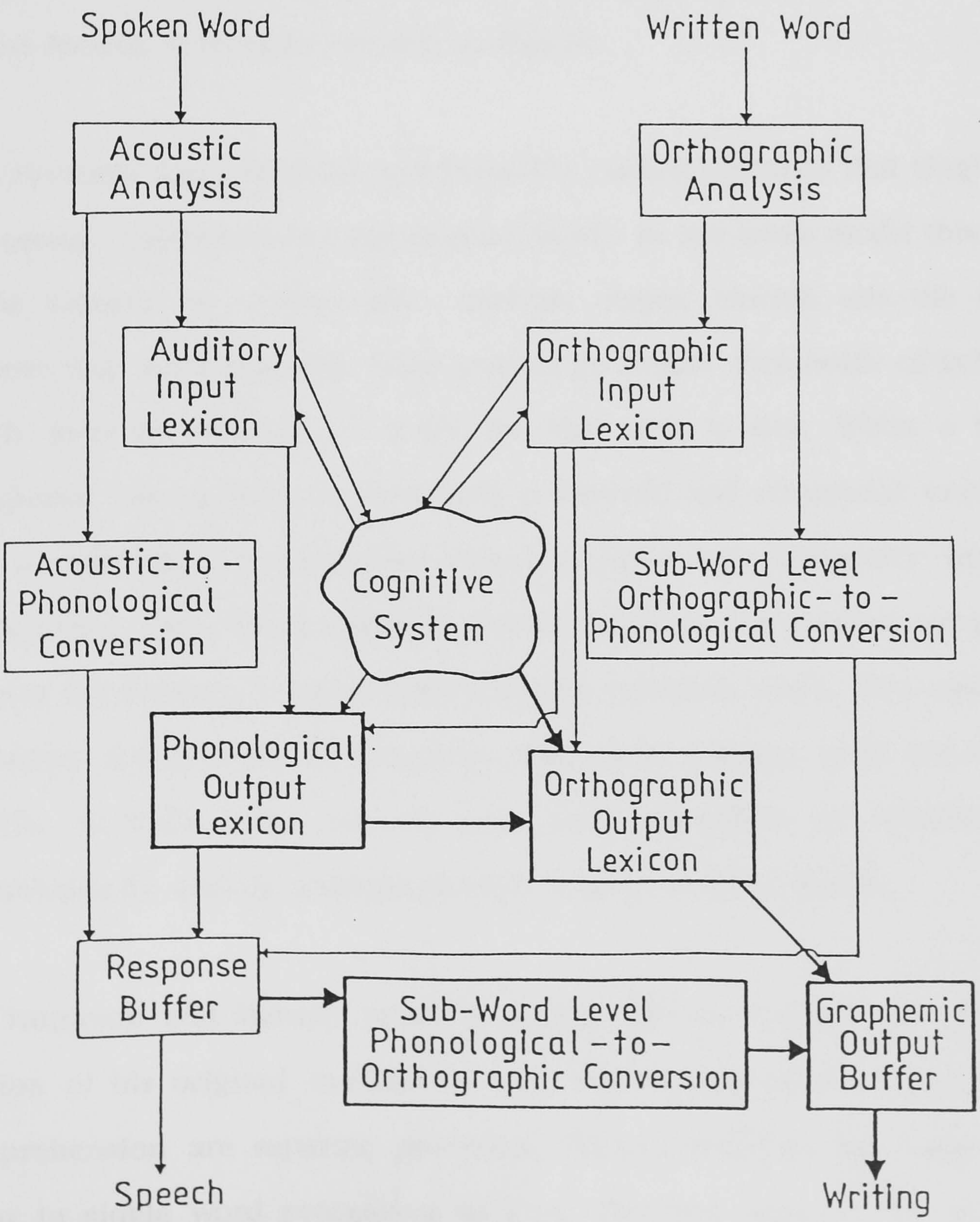


Figure 1.1 shows the Patterson and Shewell (1987) model of single-word processing, which represents a class of functional models. The model posits a number of different stages in the processing sequence that consist of a common semantic system with a total of four stores: a separate input and output lexical store and a separate phonological and orthographic store. These separate stores account for different routes from input to output, including lexical, semantic and non-lexical routes. The model is very much based on Morton's (1969) 'logogen' model, one of the earliest and most frequently outlined in picture and word naming studies despite the original outline having undergone several revisions.

Both Morton's and Patterson and Shewell's models postulate that single word processing commences at a recognition level - in the latter model this occurs at the acoustic or orthographic analysis stages. Morton was the first to propose that word detection units possess particular thresholds of activation which must be reached in order for that unit to fire. When a word is recognised successfully its threshold is lowered and sequential encounters with a word lead to a permanent lowering. Since high frequency words are encountered often, the thresholds of their logogens are lowered compared to those of low frequency words which remain relatively high. This makes high frequency words easier to recognise. Moreover, logogen units are lexically specific so each word has its own unit, regardless of whether it is phonologically and/or orthographically similar to other words.

The Patterson and Shewell model is similar still to Morton's (1985) adapted version of his original model, and both assume that word recognition and comprehension are separate processes. Morton describes the stages which occur in single word processing as thus. The first stage in the process is pictorial analysis which involves pattern classifiers, "...in other words, there is a stage or procedure at which a printed word is recognised or categorised as a token of its type" (Patterson & Coltheart, 1987). The next process in the sequence is that of categorisation of the object into the pictogen system, where a recognition search is performed on the stimulus in order for it to be classified as familiar or unfamiliar, that is the search entails matching the analysed stimulus against existing representations. Alternatively, the information is fed directly into the semantic system where it triggers semantic representations which contain meaning and knowledge about the object. From the semantic level, information is fed to the phonological lexicon, where output logogens are housed. Phonological codes are located here and they feed onto a response buffer where a motor code for articulation is created.

The Patterson and Shewell model consists of the same stages of processing. Namely, the stages which commence the process of naming a word consist of acoustic or orthographic analysis, which pass onto an auditory or orthographic input lexicon. These feed into a cognitive system from which information is passed to a phonological or orthographic output lexicon, ready to feed onto a response buffer for articulation.

For both models, the process is similar for word reading with the existence of three routes from a visually presented word to articulation (Morton & Patterson, 1980). The first entails the word being analysed graphemically and categorised at the visual input logogen level. The information then passes to output logogens, which enables retrieval of the appropriate phonological code. Secondly, the word is submitted to graphemic analysis and categorisation. The output of this feeds in to the cognitive system and the item's semantics are then retrieved to activate the output logogens and then produce the spoken word. Finally, a grapheme-to-phoneme conversion process is also available and in this case, reading aloud does not pass the logogen system.

The frameworks for these models are supported by a substantial amount of experimental data which justify the stages and connections (Lesser & Milroy, 1993). These take the form of patient studies as well as studies of normal participants.

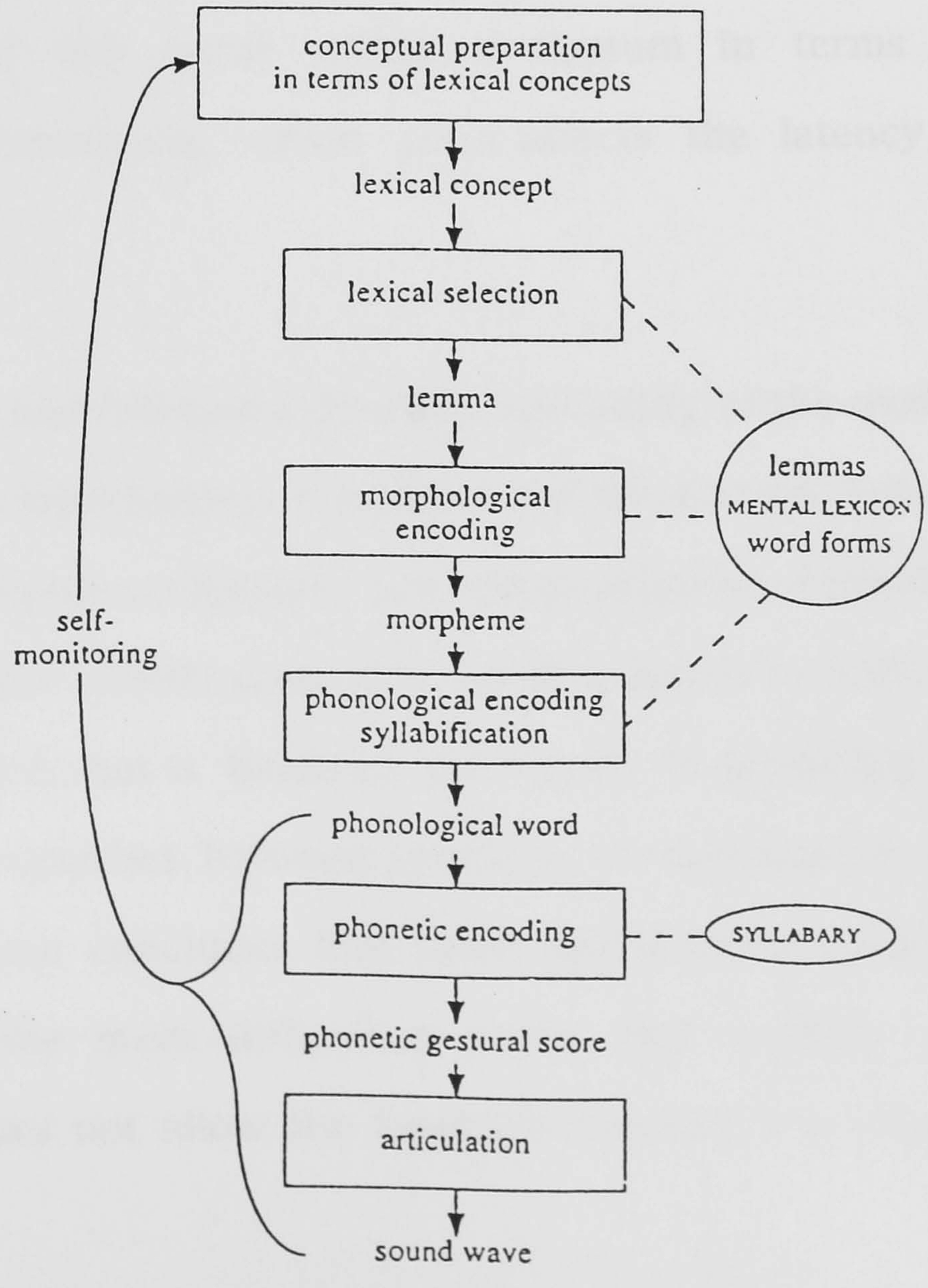
1.3.2. Spreading Activation and Interactive Activation Models - Dell's (1986) Spreading-Activation Theory of Retrieval

Dell's theory is based on spreading activation and falls into the general class of theories including interactive activation models (McClelland & Rumelhart, 1981; Stemberger, 1985). Whereas many two-stage models assert that semantic and phonological access are non-overlapping stages operating on different inputs, a contrasting view is the interactive two-step hypothesis (Dell, 1986; Harley, 1984) which arranges lexical access in a more continuous manner. Dell's (1986) theory deals with what Garrett (1975) terms the 'sentence production process' by which the semantic representation of a sentence to be spoken is translated into a phonetic representation guiding articulation and generates speech. The model progresses from meaning to sound by the process of *syntactic encoding* whereby words are selected and ordered in accordance with rules of grammar. The words are then specified in terms of constituent morphemes (*morphological encoding*) which must be spelled out in terms of sound before finally reaching the process of *phonological encoding*, the level that Dell's theory deals with in most detail.

Dell and Reich (1981) and Dell (1986) looked at lexical bias effects in the production of phonological errors - i.e., where an error in retrieving a phonological form leads to the production of an existing word - and mixed-error bias - where error words share semantic and phonological properties of the target word. Both studies are in agreement with Fromkin (1973) that "...the inner workings of a highly complex system are often revealed by the way in which the system breaks down". They report that the two processes are unlikely to be completely independent since sound errors tend to create lexical items and because interacting words in word blends, substitutions and misordered errors tend to be phonologically related. This is explained by viewing the lexicon in terms of spreading activation between nodes and Dell and Reich propose that information can leak between stages and cause the decision making at a stage to be affected in a probabilistic manner by information from other stages.

1.3.3. Levelt's (1989) 'Speaking' model and Levelt, Roelofs and Meyer (1999)

Figure 1.2. An Outline of Levelt's (1989) 'Speaking' Model



Levelt's (1989) 'speaking' model (Figure 1.2) in its recent form (1999; Levelt, Roelofs & Meyer) provides a fuller account of the later stages of the Patterson and Shewell model and of the speaking process, although most of the work which has been carried out on it has been in Dutch. The model is more specific in describing the processes from concept to articulation. As with other current models of speaking (Bock, 1982; Dell, 1986; Garrett, 1980; Kempen & Huijbers, 1983) it initially consisted of three autonomous processing stages: the *conceptualizer*, the *formulator* and the *articulator* and of four stages of speech production: *message generation, grammatical encoding, phonological encoding* and *articulation.* Levelt et al. (1999) upgraded the model to incorporate the three strata of a conceptual stratum, a lemma stratum and a form stratum, but essentially the framework remains unchanged, and is modelled in terms of an essentially forward activation-spreading network. There are no inhibitory links in the network, either within or between components. However, according to Levelt et al. competition may still occur within a stratum in terms of the state of activation of non-targets, which then affects the latency of target node selection.

This modularity and forward-activation spreading of the model has important assumptions for functioning. It implies that interaction between components is impossible, so each component acts independently of previous or following processes. Poulisse (1997) compares Levelt's model to Dell's (1986) model of speech production that is based on the theory of spreading activation. Dell's model also distinguishes between syntactic, morphological and phonological encoding. Poulisse concludes that Dell's and Levelt's models are similar in many ways - the main difference being that Levelt's model is strictly modular and does not allow for feedback between the various components.

For purposes or brevity, this thesis will mainly concentrate on Levelt's model.

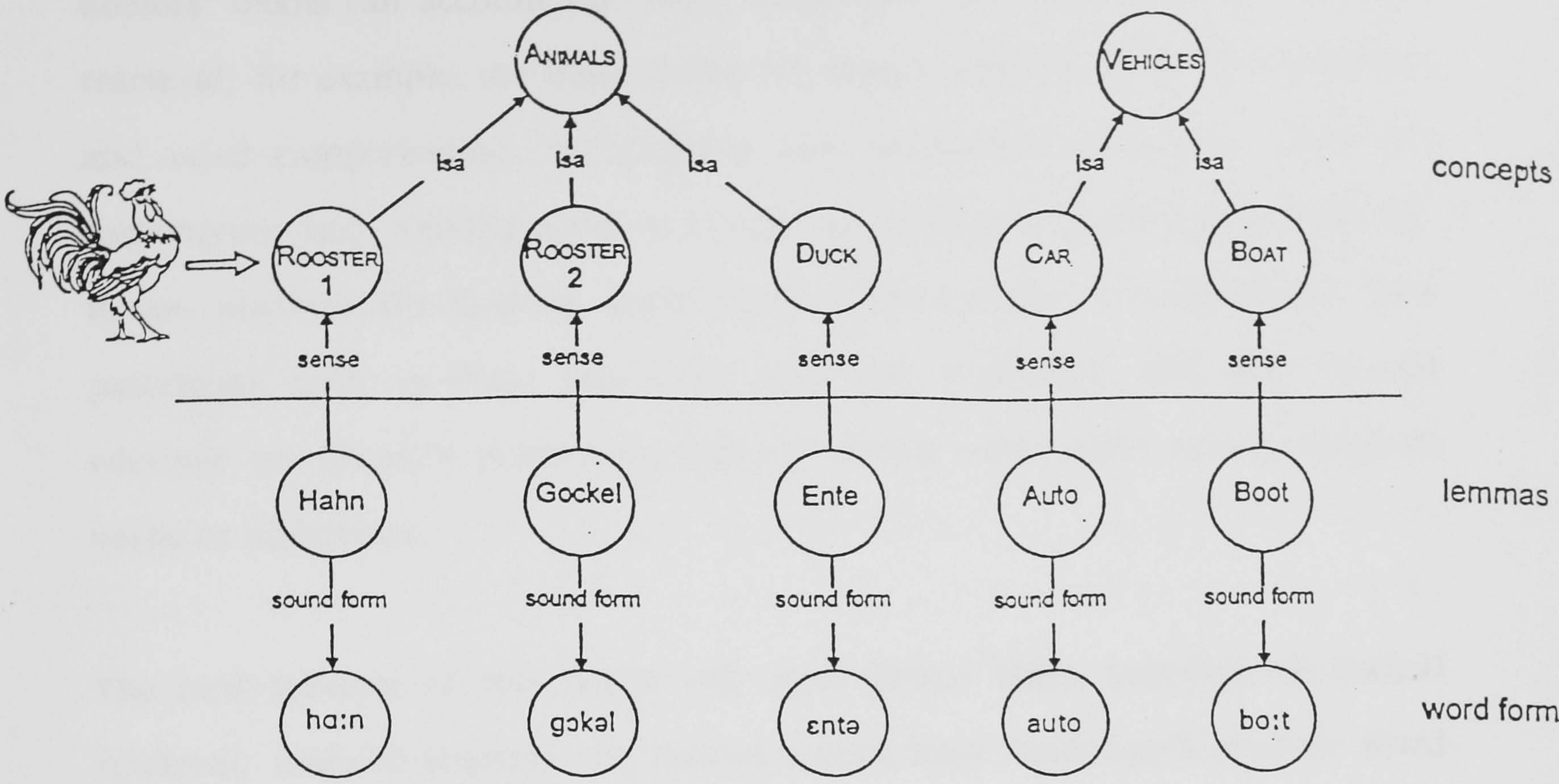
The conceptualizer generates preverbal messages which contain all information necessary to convert meaning into language, but which are not themselves linguistic (Bierwisch & Schreuder, 1992, and Garrett, 1991 also claim that are they are not language specific). The conversion from meaning to language involves planning of the content (macroplanning) and form (microplanning) of messages. According to Levelt (1989) macroplanning involves elaborating a communicative goal by selecting the information needed to express these goals, whereas microplanning involves conceptual planning such as planning informational perspectives, marking information status of referents as given or new, and assigning a topic and focus. Message generation is influenced by the speaker's knowledge of what has already been said, situational and encyclopaedic knowledge. The preverbal message is converted to a speech plan via selection of words or lexical units and application of grammatical and phonological rules at the formulator.

Lexicalization is the set of processes in the formulator which govern the retrieval of lexical items from the mental lexicon. Lexical items may be decomposed into two parts: the *lemma* and the *lexeme* (Levelt & Schriefers 1987). This formulation is consistent with Kempen and Huijbers' (1983) model of lexicalization where processes are also divided into two stages: 'L1', a first stage leading to a store of abstract, pre-phonological items with syntactic specifications and 'L2', a second stage retrieving or assembling phonological shapes of items. In the Levelt model, semantic and grammatical details specific to a particular word (i.e., its meaning and syntax) are available from the lemma whereas the lexeme carries morphological and phonological properties. Matching the meaning part of the lemma with the semantic information from the preverbal message activates lexical items. This then activates syntactic information and grammatical encoding which results in a surface structure processed by the phonological encoding. In the final stage, the articulator converts the phonetic plan to overt speech. As the model includes a self monitoring system, speakers are able to parse internal and overt speech with the result of this being fed back into a monitoring device in the conceptualizer, thus enabling speakers to evaluate their messages and avoid or repair speech errors. This is relevant to spoken word production latency, as the process of self monitoring could affect duration.

In Levelt's (1989) view, and indeed in the view of others (e.g. Green, 1993), the speech production process is incredibly fast and highly automatic. The message generation and monitoring parts require continual attention - and are therefore controlled activities - but the other processes are executed without conscious awareness, perhaps with the exception of encountering low frequency words. Levelt questions whether an item's lemma and word form are retrieved simultaneously or successively during lexical access. He concludes that lexical retrieval occurs successively and proposes that the stage may be divided into two further steps and so represented as a two-stage model. Studies on speech error analysis (Dell & Reich, 1981; Garrett, 1988) tip-of-the-tongue states (Brown, 1991), reaction time and lexical decision experiments and patient studies (e.g. Badecker, Miozzo & Zanuttini, 1995) provide evidence for these two stages in lexical retrieval.

De Bot and Schreuder (1993) argue that some of the basic tenets from Levelt's model may be taken as a starting point for a model of bilingualism. A large amount of psycholinguistic evidence exists in favour of the model. It is based on several decades of empirical data (e.g. Bock & Eberhard, 1993; Bock &

Figure 1.3. A Section of the Conceptual-Lexical System Involved in Speaking (Roelofs, 1992; taken from Jescheniak & Schriefers, 1998).



Levelt, 1994; and Caramazza, 1997, describe some of these studies in depth) and earlier theoretical proposals such as those by Garrett (1975), Dell (1986) and Kempen and Hoenkamp (1987).

1.3.4. Roelofs' (1992) Spreading Activation Theory

Roelofs (1992) proposes a theory of spreading-activation which still encompasses this two-stage modularity, although his work concentrates on the first stage of lexical access in speaking of conceptually driven lemma retrieval (see Figure 1.3) Here, lexical items are specified with regards to meaning and then syntactic properties are activated and selected. According to Roelofs' arrangement, the lexicon is arranged as a network made up of concept, lemma and word form nodes with labelled links. Each lexical concept is represented as an independent node, and increasing activation to the node of a particular concept retrieves a lemma. The activation then spreads towards lemma level with the highest activated lemma node selected.

Roelofs' model can account for many empirical findings relevant to lemma retrieval, for example, the time course for object naming and categorisation, and word categorisation. In addition, his assumptions are also valid for hypernymy (e.g. naming a *car* as a *vehicle*) and word-to-phrase synonymy. It now requires for Roelofs' model to be tested further by employing new paradigms such as those requiring syntactic encoding and also to test whether the theory's predictions hold for words other than nouns, such as verbs or adjectives.

The next sections of this thesis will now divert from theories of lexical retrieval, and will examine the factors which have been implicated in word and picture naming in English and other languages.

1.4. Factors Affecting Speeded Object Naming in English

The factors which have been examined in English object naming are: visual complexity, familiarity, name agreement, frequency, age of acquisition and length. Although these variables have been studied, not all have been shown to exert significant effects.

1.4.1. Visual Complexity

The standardised set of pictures used in the experiments of this thesis are those produced by Snodgrass and Vanderwart (1980) to provide consistency of pictorial representation in studies of picture naming. Morrison, Chappell and Ellis (1997) expanded the original set by adding items redrawn in a similar style or by redrawing some of the items considered outdated or inappropriate for British participants. One of the variables that Snodgrass and Vanderwart had their original 260 pictures rated on was visual complexity. This refers to the amount of detail and intricacy of each picture.

A picture's complexity reflects the superficial visual characteristics of an object. Therefore, picture naming, a task requiring at least two steps of picture recognition and name retrieval, might take longer if the recognition stage involves more complex pictures, with this difference originating in its earlier stages. Snodgrass and Vanderwart asked subjects to rate the pictures on a 5-point scale with 1 being defined as a very simple and 5 a very complex picture. They found that visually complex pictures tended to have many names, tended to show low image agreement and to be rated as unfamiliar. Thus, visual complexity correlated with the variables of name agreement, familiarity and image agreement although these correlations were low, suggesting a level of independence between these attributes of the pictures. Since this finding, no other studies have been found to show effects of visual complexity in picture naming.

Similar to visual complexity is the notion that the extent to which an object shares visual features with other objects will affect object naming. This was explored by Humphreys, Riddoch and Quinlan (1988). They demonstrated that according to cascade models, the effects of structural similarity may be observed subsequently to accessing structural descriptions and might interact with other variables which affect the later stages of object recognition (e.g. picture name-frequency).

1.4.2. Familiarity

A variable commonly acknowledged to exert effects on object naming in English is familiarity (Oldfield, 1966; Rochford & Williams, 1965). Gernsbacher (1984) described the inconsistencies concerning interactions between word frequencies and other variables such as orthographic regularity evident in the literature, and used rated familiarity instead of objective word frequency. No interaction was found between the two variables. However, Brown and Watson (1987) describe the problem with Gernsbacher's results, in that the ratings could simply reflect *experiential* frequency - there could be confound effects of frequency on an object's perceived familiarity. An object's familiarity may be distinguished from its frequency, in that familiarity is a semantic variable whereas frequency is a lexical one. Hence, rated word familiarity is very different to rated concept familiarity. It is not the case in everyday life that objects seen often are named on each occasion. In an examination of Rubin's (1980) study whereby 125 words were taken and measurements on a range of variables obtained, Brown and Watson found that rated familiarity correlated most highly with rated pronunciability, associated frequency, age of acquisition and four objective frequency measures. Brown (1984) had found that rated familiarity was more highly correlated with spoken than with written word frequency, and it was most highly correlated with age of acquisition.

1.4.3. Name Agreement

Name agreement (or *codability*) is the extent to which participants agree on the name for a given object. Lachman (1973) and Lachman, Shaffer and Henrikus (1974) found effects of a variable named *codability* - the uncertainty of the distribution of names given by participants in response to item presentation. It was found that objects with low codability (that is, objects which had been given several names by participants) took longer to name than those which were highly codable (which had one or very few names). It was suggested in the former study that when an object has high codability the semantic representation provides direct access to its name within a lexicon, and a minimum time is required for this. With the low codability objects however, selecting and deciding on one name amongst many takes longer than when there is direct access to the name being located.

Other authors to find naming latencies to become slower as number of different names per objects becomes greater, include Paivio, Clark, Digdon and Bons (1989). Rather than attributing their findings to the decision process, they account for them by describing how the number of different names may contribute to one specific factor. They provide two theoretical explanations for this. Firstly, activation may be less strong when it is spread over several pathways. Secondly, names which are in competition may be inhibiting one another, and this may delay the production of a particular response.

According to Vitkovitch and Tyrrell (1995), these explanations pertain to the final stage of naming - they are the reason for increased reaction times for objects with low name agreement. They investigated the issue of object naming disagreement and replicated the finding that low name agreement objects were named more slowly than those with high name agreement. Specifically, they found that objects which were low in name agreement because of having lots of names (*sofa-settee-couch*) were named more slowly than those with only one name, but objects with low name agreement due to the availability of a shorter name (e.g. television-*TV*) did not. The results indicate, therefore, that it is the availability of different names that leads to the lengthening in reaction times.

Vitkovitch and Tyrrell conducted a second experiment to investigate whether these longer reaction times for objects with multiple names were due to interference occurring at different processes in the process of recognition and naming. They conducted an object recognition task to see if the RT differences in naming occurred early on in processing and found that participants took longer to recognise objects when low name agreement was due to incorrect naming than for objects with high name agreement. This suggests that the longer latencies for items with name agreement occur as a result of difficulties before the structural stage - results consistent with Humphreys et al. (1988). Furthermore, no differences in object decision times were found for high and low name agreement when disagreement was as a result of an item having different names. This suggests that these stimuli do not encounter any delay early on in the recognition process. However the authors do not rule out the possibility of different conceptual representations underlying each correct name for the object, and delayed semantic processing resulting in activation of different correct names from the various semantic descriptions may occur as a consequence of this.

1.4.4. Frequency

Oldfield and Wingfield (1964; 1965) used the Thorndike-Lorge (1944) frequency count to examine object naming latency and found effects of word frequency. They found that the difference in reaction times between naming pictures in the high and low frequency halves of their list was 330 ms. In an attempt to explore the sources of word frequency effects on naming reaction times, Wingfield (1968) obtained an estimate of the exposure durations necessary for visual processing and object recognition. In an examination of reaction times to pictures with the highest and lowest frequency names, he found differences of only 15-25 ms and concluded that this difference in naming latency could not solely be due to differences in recognition time.

Kroll and Potter (1984) performed a pictorial version of a lexical decision task: an 'object decision' task, in an effort to address the issue of whether pictures and words share a common conceptual representation. They presented pictures depicting real or pseudo-objects, and compared participants' reaction times to a word version of the same experiment (i.e. a straightforward lexical decision task). Half of the positive items were of a high and half were of a low frequency, as measured using the Kucera and Francis (1967) word count. Response times and error rates for the word and object version of the tasks were comparable and none of the differences between the two tasks was significant. An analysis on the 'yes' responses found that there was a significant effect of frequency for both tasks despite the fact that the frequency measure employed was one for printed words. One of their criticisms of the study was that this influence might have been due to familiarity, for which they did not control. The authors attribute their findings to conceptual rather than to lexical or visual frequency. However, they argue that since word frequency correlates with object frequency, the two frequency effects could reflect modality-specific processing.

The effects of word frequency in object naming have been somewhat ambiguous. Lachman, Shaffer and Henrikus (1974) found effects of frequency and age of acquisition as well as effects of codability (i.e. name agreement). Some authors argue that frequency effects disappear once the natural correlation of frequency and AoA is controlled (Carroll & White, 1973; Gilhooly & Gilhooly, 1979) whilst other authors argue that frequency has effects independent of those of AoA (Lachman et al., 1974 - although it is interesting to note that these studies used subjective measures of word frequency). On the one hand, strong AoA but no frequency effects have been found in studies by Morrison, Ellis and Quinlan (1992) and Vitkovitch and Tyrrell (1995) and this contrasts with studies by Snodgrass and Yuditsky (1996) and Barry, Morrison and Ellis (1997) which have found word frequency effects which are stronger than AoA effects.

1.4.5. Age of Acquisition

It was the oft-cited study by Carroll and White (1973) which first reported sole effects of age of acquisition in object naming as well as correlations between naming speeds and word frequency for line drawings, and even higher correlations with estimates of AoA. Prior to this, Oldfield and Wingfield (1965) examined object naming latency and found effects of word frequency, using the Thorndike-Lorge (1944) frequency count. Since this study had omitted to take AoA into account Morrison, Ellis and Quinlan (1992) re-analysed this data and found that when the three variables of word frequency (from Kucera & Francis, 1967), age of acquisition and phoneme length were employed it was only AoA and not frequency that emerged as a single predictor of naming latency.

Following these initial investigations, the rôle of AoA in picture naming has become firmly established both independent of and alongside other variables. Lachman (1973) and Lachman et al. (1974) found effects of both AoA and frequency and effects of name agreement. Gilhooly and Gilhooly (1979) reported a strong effect of AoA but not frequency when AoA was controlled for, findings which were replicated by Vitkovitch and Tyrrell (1995). More recently, Snodgrass and Yuditsky (1996) and Barry, Morrison and Ellis (1997) and Ellis and Morrison (1998) and have reported significant and independent effects of both AoA and frequency.

The effect of AoA as a significant predictor of naming speed still manifests itself when as many as seven variables are applied. Ellis and Morrison (1998) entered both age of acquisition and frequency into a multiple regression analysis along with the five other variables of imageability, name agreement, concept familiarity, word length and visual complexity of drawings. They found that only age of acquisition was a significant predictor of naming speed.

The methods of obtaining age of acquisition measures for object names have been twofold. One manner is to obtain a measure from retrospectively collated subjective ratings (e.g. Carroll & White, 1973) and the second manner is to obtain a measure objectively, directly by gathering normative data showing the age at which children acquire different object names. Morrison, Chappell and Ellis (1997) collected objective measures by asking 280 children aged between 2 and 10 years to name drawings of objects, and found that the two measures correlated highly at .759.

1.4.6. Length

Effects of phoneme length in picture naming were found by Morrison, Ellis and Quinlan (1992), although previous studies failed to find effects of it (Oldfield & Wingfield, 1965, Carroll & White, 1973; Lachman et al., 1973; Lachman, 1974; Gilhooly & Gilhooly, 1979). However, only Carroll and White included length as an independent variable and other authors have ignored it as a variable in picture naming despite its high correlation with naming speed (Gilhooly & Gilhooly, 1979).

In terms of models of word retrieval, length is an important variable because it can be used to distinguish between cascade and parallel processing. Models such as that of Levelt (1989) assume that the segmental units of words are inserted into an articulatory plan, with segmental units being specified one after another and with speech production occurring only after a plan is complete (Levelt, 1992; Meyer, 1990). This accounts for results where bisyllabic words are uttered slower than monosyllabic ones (Eriksen, Pollock

& Montague, 1970; Klapp, Anderson & Berrian, 1973). Short words require less planning and so the articulatory process can begin sooner than it can for longer words. The problem lies in the difficulty of models with parallel insertion of the segments (e.g. Dell, 1986) to account for length effects.

Despite failing to find syllabic length effects in English picture naming, Bachoud-Lévi, Dupoux, Cohen & Mehler (1998) point out that some of the reported length effects could actually be due to the input phase in word reading, or to interference from grapheme-to-phoneme conversion rather than to phonological planning alone. In an attempt to control for the confounding variables, they performed picture naming studies on sets of fifteen pictures with monosyllabic names and fifteen with bisyllabic names (Experiment 3) matched for familiarity and frequency (but not AoA or other factors known to be implicated in picture naming), and found no difference in length for the naming of bi- or mono-syllabic pictures in English.

1.5. Naming in Italian

Much of the work on object and word naming has been carried out in English. The Italian language is of interest because it has grammatical gender. It has the two genders of masculine and feminine, whereas English has no grammatical gender. According to Levelt's theory grammatical gender is encoded at a pre-lexical level. When a speaker selects a given word from the lexicon, the first part of lexical information necessary is the word's syntax. This holds certain implications for languages containing grammatical gender, for more syntactic activity must be present as the speaker has to also first select the word's gender. Thus, in comparison to object naming in English, object naming in languages with grammatical gender should take longer due to increased lemma activity. Evidence for these two-stage models of lexical access where gender is encoded at the lemma and where lemma activation precedes lexeme access comes from studies employing the tip-of-the-tongue (TOT) procedure. Vigliocco, Antonini and Garrett (1997) investigated the retrieval of gender information in Italian participants who were in a 'TOT' state and found that participants could report the target gender of a word they had problems producing 84% of the time. It was unlikely that participants guessed gender in the basis of word ending, as performance was equally good when participants had to report the gender of words whose endings did not correlate with their gender. It was also found that the availability of gender information was not related to the availability of the word's phonological features such as number of syllables or phoneme identity. The probability of recalling gender correctly was the same for cases where participants did and did not give correct phonological information.

In another TOT study, Miozzo and Caramazza (1997) asked Italian participants in a TOT state to signify the grammatical gender and initial and final phonemes of the word. It was found that participants were more able to provide this correct information when they were in 'TOT' than in 'Don't Know' (DK) states. Miozzo and Caramazza took the proportions of gender and phoneme hits occurring with DK responses as baselines for chance-level performance. However, the authors noted that the retrieval of gender in TOT states was correct 71% of the time and the initial phoneme of the word was correct 72% of the time. Two-stage models of lexical access predict that the recognition of gender in TOT states should be better than the recognition of the initial phoneme, as the first is available at lemma access and the second is not available until lexeme access. Miozzo and Caramazza suggested that their results were consistent with a model of lexical access where selection of a lemma node sends activation in parallel to both grammatical and phonological information. In conclusion, these two studies in particular emphasise the fact there is activity occurring at the lemma level as a result of grammatical gender in Italian. As English does not have grammatical gender, it is safe to assume that this activity is non-existent when an English speaker retrieves a word.

1.5.1. Speeded Object Naming in Italian and Other Languages

Despite a handful of studies involving investigation of normative data for the Snodgrass and Vanderwart pictures in other languages (Sanfeliu & Fernandez, 1996, collected familiarity ratings in Spanish; Barry, Morrison & Ellis, 1997, compared the familiarity ratings of Welsh participants, a few of whom would have been Welsh speakers, with the original Snodgrass and Vanderwart American raters) few studies reporting factors affecting naming in other languages exist.

For object naming, almost all studies have been in English. Although no studies exist for Italian picture naming, it is fortunate that studies exist in Spanish, which is very similar to Italian and shares the same linguistic root. One of the first attempts to extend observations of object naming to other languages was made by Goggin, Estrada and Villarreal (1994). They examined responses to 264 pictures which were mainly from the Snodgrass and Vanderwart set, using monolingual and bilingual Spanish and English participants who varied in rated skill across the two languages. It was found that name agreement decreased with language skill. Name agreement was also lower in Spanish than in English, and was found to correlate with word frequency and length.

Cuetos, Ellis & Alvarez (1999) collated Spanish normative data for object familiarity, rated age of acquisition, visual complexity, image agreement, name agreement, word length and four measures of word frequency.

Multiple regression analyses were conducted and significant independent effects were found of AoA, familiarity, name agreement, frequency and word length. It is interesting to note here that one of their frequency measures was based on child language samples, but the one to exert a significant independent contribution was based on adult language samples. It could be then, that once AoA is accounted for, the most relevant measure of word frequency is that with which adults use words in quotidian life. Word length does not tend to emerge as significant in English naming but it did in Spanish naming, when expressed in terms of syllables. This could reflect further differences between the two languages. First, Spanish is a syllable-timed language but English is a stress-timed language and second, the object names in Spanish covered a wider range of syllable lengths which allowed for a length effect to be easier to assert. Cuetos et al. (1999) also found that the global mean latency for Spanish participants naming objects was 829 ms, higher than reaction times previously found for English participants (794 ms in Ellis & Morrison, 1998).

Jescheniak and Levelt's (1994) study examined immediate- and delayed-naming speeds to objects with names of high and low frequencies which were presented three times to Dutch participants (Experiment 1). They found a substantial effect of word frequency on all three repetitions on immediate naming, which disappeared for delayed naming. In the same study (Experiment 3) they asked participants to categorise objects according to the gender of their names, turning the task into a binary one by having participants press one button for *de* words (masculine or feminine) and another button for *het* words (neuter). They found that for this task there was an effect of frequency in the first presentation of the sets, but it disappeared by the third presentation.

This led Jescheniak and Levelt to conclude that frequency effects arise in the name retrieval process rather than in the articulation process. The frequency effect in the first presentation of the gender classification task occurred because participants were naming the item, thus accessing its lexeme, but with repeated presentations they were able to rely on lemma access solely. The study did not control for age of acquisition, and in a separate analysis, Ellis and Morrison (1998) found that most of Jescheniak and Levelt's high frequency items were those which had been rated as being learned earlier in life than the low frequency items by English participants. Although this analysis compared Dutch naming speeds with English AoA ratings, it was reasoned that the cultural experiences between the two nationalities are not so dissimilar to render the English AoA data inapplicable to Dutch speakers. Levelt et al. (1999) acknowledged that this manipulation of frequency by Jescheniak and Levelt (1994) was also a manipulation of age of acquisition, and suggested that both word frequency and age of acquisition determine the speed with which a spoken word-form (lexeme) can be activated and produced once its corresponding lemma has been accessed.

Bachoud-Lévi et al.'s (1998) picture naming study examining (the lack of) length effects consisted of a picture naming study and used French participants (Experiment 1). They used thirty pictures from the Snodgrass and Vanderwart set, in French, half of which were monosyllabic and the other half of which were bisyllabic. The study failed to find length effects in French, but did find effects of familiarity and frequency - the only other variables that the words were matched on.

It is therefore difficult to make direct comparisons between English and Italian object naming given the few studies that exist. Based on these studies, however, it is apparent that the variables affecting Spanish and French object naming are on the whole, consistent with those which affect English naming: familiarity and frequency for French, along with name agreement, AoA, and word length for Spanish. Furthermore, in Dutch it is possible to separate the two processes of naming and gender classification, with AoA and frequency affecting naming but not gender. This is of benefit in respect to the Italian language as it provides evidence that the two processes of gender classification and naming are distinct, with gender classification occurring with lemma retrieval and (successful) object naming occurring with further access to a word's lexeme.

1.6 Reading in English

1.6.1. Orthographic Depth

"In many regular languages a small set of grapheme-phoneme correspondences can unambiguously define all of the utterances in the language" (Bridgemen, 1987)

The lexicon contains lexical entries for every word known by a reader, but this notion is expanded further when we take into account the existence of at least two types of lexical representation in the form of a separate orthographic and the phonological lexicon. As has been described in this chapter, the phonological lexicon specifies lexical entries in terms of a word's sound, whilst the orthographic lexicon specifies them in terms of their spelling.

Orthographies may be described as being either deep or shallow. This depends on the ease of predicting a word's pronunciation from its spelling. Deep orthographies such as the one employed in the English language, have an indirect correspondence between spelling and sound, and it is necessary for readers to learn arbitrary or unusual pronunciations of irregular or inconsistent words (e.g. *yacht* or *blood*). In contrast to this, shallow orthographies such as the one employed in languages such as Italian or Spanish, have direct spelling-sound correspondences. That is, sounds are predictable from spellings and given the rules, words may be named correctly immediately.

According to the orthographic depth hypothesis, reading of words from shallow and deep orthographies are different processes. Words from languages whose orthography has consistent spelling-sound correspondences (shallow orthographies) require less semantic involvement when being read aloud since these words are unambiguous. However, with words from deep orthographies where sound is not predictable from spelling, semantic involvement is necessary. For example, in English this involvement would be necessary to know whether *rain* or *reign* is the word required, or to know the pronunciation for the cluster *ou* in the words *enough, pour, cough, dough, bough, thought, through* etc. Without lexical representation there is no reliable manner to know which is the correct pronunciation to be assigned to the cluster in each word.

1.6.2. Distributed Memory Models - Seidenberg & McClelland (1989)

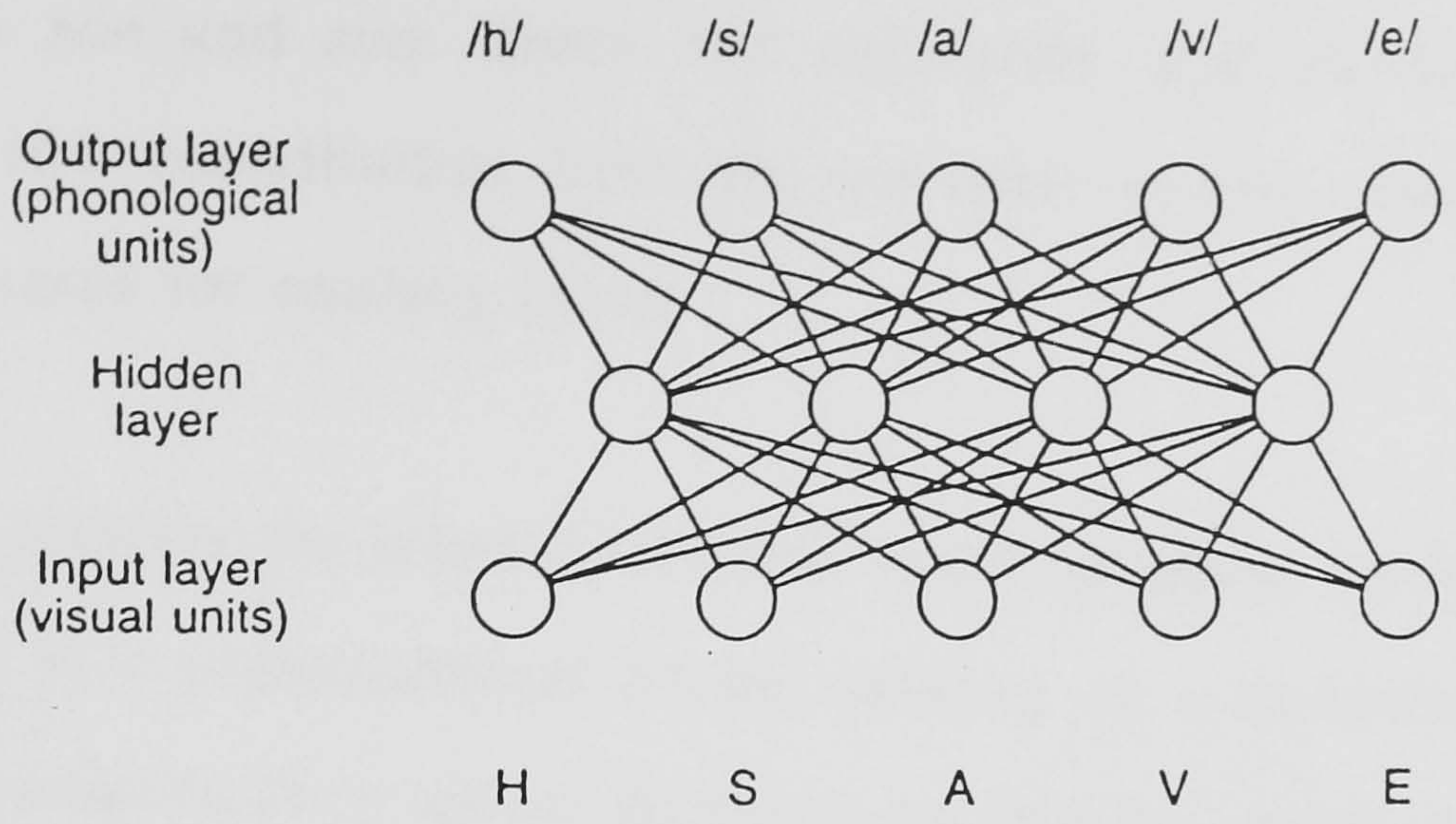
Early connectionist approaches such as that of McClelland and Rumelhart (1981) resulted in the formation of interactive activation and competition models. These models involve information being passed around input levels consisting of nodes corresponding to letters, and an output level of nodes corresponding to words. The process occurs via activation. When activation occurs, each unit passes activation on to nodes in the level before and after. Activation may be excitatory or inhibitory; it may encourage or discourage the flow of information. Nodes have their own respective resting levels of activation determined by frequency with which the representation is used.

Seidenberg and McClelland's (1989) parallel distributed model of visual word recognition attempted to convert orthographic inputs into phonological outputs (see Figure 1.4). There are differences in the connection strengths and between different units which correspond to differences in frequency. The distributed nature of the PDP means that correct identification of a word is dependent on the correct activation of a certain combination of units at any given level, so although different items may share the same units, the distributed representation for each item is unique.

The advantages of this type of model are many. This type of model is explicit, and can implement box and arrow models in a relatively straightforward way. It allows for recognition of an item on the basis of partial information and so can account for spreading activation between items. The PDP model is able to emulate certain aspects of word recognition (such as showing a regularity effect) and can differentiate between words in terms of their processing difficulty. It also shows generalisation, performing better on some non-words than others. Another strength of the model is that increasing damage to it causes graceful degradation of performance. Patterson, Seidenberg and McClelland (1989) "lesioned" the model to simulate human impairment by switching off 60% of the hidden (or intermediate) units This caused it to behave rather like a surface dyslexic, showing regularisation errors (such as pronouncing *pint* as /pint/ rhyming with 'hint') on 24% of irregular words. Performance was particularly bad for low frequency, irregular words.

The theoretical impact of the PDP model was, however, stifled by certain inadequacies. A general disadvantage is that this type of model does not 'learn', as the weights are set in the initial set-up. Secondly, there are also

Figure 1.4. Breakdown of the Architecture of the Seidenberg and McClelland Model of Single Word Reading (taken from Harley, 1995).



weaknesses in its match with human performance. The model was worse than skilled readers when producing non-words (Besner, Twilley, McCann & Seergobin, 1990). It was unable to produce lexical decisions accurately under many conditions (Besner et al., 1990; Fera & Besner, 1992). Fera and Besner argue that the model does not represent orthographic familiarity accurately. However, models of this nature offer a further perspective on word recognition and production models, and resolve many of the issues associated with serial formats.

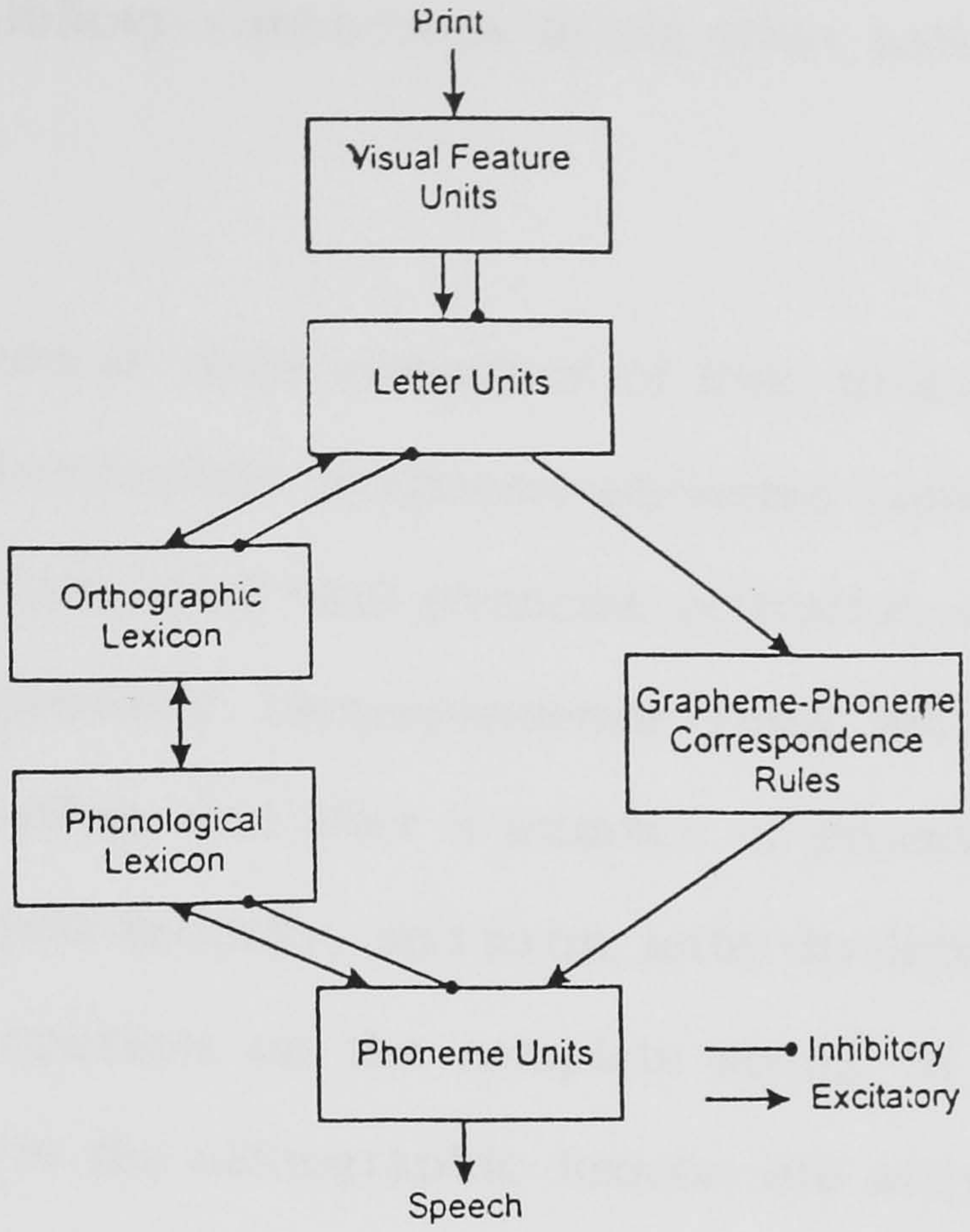
1.6.3. 'Dual Route' Models

The term 'dual route' refers to the two different procedures which exist for converting print to speech. There is a wide range of literature providing evidence in support of a dual route arrangement (Coltheart, 1978, 1985; Ellis & Young, 1988; Patterson & Coltheart, 1987; Seidenberg, 1985). In fact, most traditional dual route models actually have three routes of translation from print to sound. The first is a lexical route involving visual input lexicon to speech output lexicon links. The second is a sublexical, grapheme-to-phoneme conversion route. The third is a lexical route via the semantic system. It is this latter route that would assist the English speaker to decide between *son* and *sun*. Given the regularity and shallow orthography of Italian, this contribution from the semantic system would be required to a lesser degree for reading aloud.

Figure 1.5 shows the latest dual-route model proposed by Rastle and Coltheart (1999). It is a computational model, existing as a computer program able to perform tasks such as lexical decision and reading aloud, with the number of cycles required to perform any of these tasks being analogous to the time required by human participants. Hence, unlike other existing models and implementations of reading aloud (e.g. Plaut, McClelland, Seidenberg & Patterson 1996; Norris, 1994; Zorzi, Houghton & Butterworth, 1998; Grainger and Jacobs, 1996) it is able to simulate both visual word recognition and reading aloud.

Rastle and Coltheart's model comprises of a lexical procedure for converting print to speech, which is a type of 'dictionary-lookup' system, and a non-lexical, rule-based procedure. The lexical route consists of five processing levels: feature detection, letter identification, orthographic lexicon, phonological lexicon and phoneme activation. The feature level consists of sets of feature units, one for each possible letter position of an input string; whilst the letter level also consists of sets of letter units which house 26 units appertaining to each letter of the alphabet. Each unit at the feature level has an excitatory connection to all of the letters for that input position containing that feature, and an inhibitory connection to those that do not. This is a uni-directional process. Within the letter level, there is within-level inhibition, that is, for each letter position, all units have inhibitory

Figure 1.5 Architecture of the Dual-Route Cascaded Model (Rastle and Coltheart , 1999).



connections to all other letter units. The orthographic lexicon contains units representing monosyllabic words and each word unit has inhibitory connections to all the other word units in the orthographic lexicon, with a parameter representing its frequency. For each position at the letter level, every letter unit possesses excitatory connections to all the other word units. Each word also has excitatory connections back to all the other letter units representing its spelling, and inhibitory connections to all the other letter unit. The phonological lexicon consists of units representing pronunciation, which are coded by frequency in the same manner as the entries in the phonological lexicon. The model can mimic heterographic homophones such as *sew* and *so* by giving them separate entries in the orthographic lexicon but the same entry in the phonological lexicon. It can also represent homographic heterophones such as *lead* by granting them a single entry in the orthographic lexicon activating two separate entries in the phonological lexicon. Finally, the phoneme level comprises of sets of phoneme units for each of the phonemes in the model's vocabulary. Each entry in the phonological lexicon has excitatory connections to all its constituent phonemes and inhibitory connections to the other units in the phonological lexicon.

The model's non-lexical route comprises of four processing levels: feature detection, letter identification, grapheme-phoneme conversion and phoneme activation. The feature, letter and phoneme activation are as for the lexical route. Grapheme-phoneme correspondence rules are applied to the first letter of an input string, and after a number of processing cycles the next letter is translated non-lexically, and so on, letter-by-letter from left to right. The process then operates on the complete string in parallel. With non-words, neighbours in the orthographic lexicon are activated, which in turn activate their phonological representations. The phoneme units also receive activation from the lexical route from word neighbours. A strength of the model lies in its application of different strengths to different grapheme-phoneme correspondence rules, e.g., with the strength of correspondence being a function of the proportion of words in which the correspondence occurs.

1.7. Factors Affecting Speeded Word Naming in English

Work concerning word reading (or word 'naming') has more to offer in terms of investigating the variables affecting it. Variables investigated for their involvement in English word naming are: word length, familiarity, orthographic and phonological neighbours, frequency and age of acquisition. Again, although these variables have been examined for their involvement in word naming, they have not always been found to exert significant effects.

1.7.1. Word Length

The effect of word length has been reported more frequently in studies of word naming (Forster & Chambers, 1973; Frederiksen & Kroll, 1976; Butler & Hains, 1979) with studies showing that naming becomes more difficult with increases in word length as measured in syllables or phonemes (Klapp et al., 1973; Katz, 1986, Tweedy & Schulman, 1982). Weekes (1997) examined the effects of number of letters on word and non-word naming latency, manipulating frequency. High and low frequency words were compared with non-words and it was found that letter length affected reaction times for low frequency words and non-words but not high frequency words. Word length is confounded with a number of other variables such as orthographic neighbourhoods and average grapheme frequency. It correlates negatively with these measures. Weekes found that when these factors had been accounted for, letter length still affected non-word latency but not the latency of naming low frequency words and the effect was lost in delayed naming. According to Weekes, the letter length effect is as a result of a sequential reading mechanism which occurs in non-lexical reading.

This notion is consistent with that of Henderson (1982), who described the effect of letter and syllable word length in word naming as occurring when orthographic information is translated into phonological information; whilst phoneme length affects articulatory planning. This account would explain why picture naming is not be affected by length as a whole, as no translation between written word and output is necessary.

1.7.2. Orthographic and Phonological Neighbours

Coltheart, Davelaar, Jonasson and Besner (1977) first introduced the notion of orthographic neighbours. These were defined as all other words of the same length which can be produced by altering one letter of a given word whilst retaining letter position. They varied the numbers of neighbours in words and non-words in a lexical decision task and found a significant effect of neighbourhood size on non-word reaction times: the non-words with more neighbours took longer to reject. There was, however, no effect of neighbourhood size in lexical decisions to real words. Findings in word reading in this area have been varied since these initial findings; many have emerged from studies in languages other than English but some of these will be included here as evidence for or against some of the arguments in the field.

The findings on orthographic neighbourhoods suggest that on visual presentation of a written word, similarly spelled words become activated. The most studied neighbourhood variable is 'neighbourhood size', the number of words in the neighbourhood of a target word. Increasing the size of this neighbourhood produces both facilitatory effects (Gunther & Greese, 1987; Scheerer, 1987, Andrews, 1989) and inhibitory effects - although these are generally confined to tasks involving lexical decision or perceptual identification tasks employing degraded stimuli (e.g. Grainger, O'Regan, Jacobs & Segui, 1989; Grainger, 1990; Snodgrass & Mintzer, 1993).

The explanation for large orthographic neighbourhoods providing facilitatory effects is that the neighbours of the visual presentation of the word are partially activated. This speeds lexical access, either because they support the identification of component letters over other competing letters that might have appeared in the same location as the target, or as a result of activity between letter and word level. This explanation is supported by the finding of facilitative effects of neighbourhood size for low frequency words in word reading (e.g., Andrews, 1989, 1992; Peereman & Content, 1995; Perea & Carreiras, 1996; Sears, Hino & Lupker, 1995). Inhibitory effects, on the other hand, could be explained in terms of search or verification models (e.g. Forster, 1976; Paap, Newsome, McDonald & Schvaneveldt, 1982). If lexical access were composed of activation of a candidate set (that is, the set of neighbours) followed by a verification stage involving a search through this candidate set for the target item, the presence of more candidates would slow the system down.

Another neighbourhood variable is that of neighbourhood frequency. This variable co-varies with that of neighbourhood size. Words with large neighbourhoods typically possess higher frequency neighbours. This variable is of importance, given the number of irregular words in the English language. In a study examining the factors influencing speeded word naming in English, Treiman, Mullennix, Bijeljac-Babic and Richmond-Welty (1995) found little effect of neighbourhood density over and above effects of phonologically defined variables, such as onset and rime consistency. However, the study did not examine the printed frequency of orthographic neighbours, and stronger effects of orthographic neighbourhood on word naming could appear with higher frequency neighbours.

Sears et al. (1995) demonstrated this neighbourhood frequency effect, finding that for low-frequency words large neighbourhoods facilitated rather than inhibited processing as did higher frequency neighbours. It seems then, that the facilitation by neighbourhood size but inhibition by neighbourhood frequency is largely due to the task in hand. Neighbourhood frequency produces interference effects in lexical decision but facilitatory effects in word naming, although Grainger (1990) found comparable effects of frequency in lexical decision and word naming tasks when the frequency of a word's orthographic neighbours was controlled (although this was in French).

Perea and Pollatsek (1994) found that when target words were embedded in sentences, there were more regressions back to words which had higher frequency neighbours, and longer fixations were found on the text immediately following these words. Hence, higher frequency orthographic neighbours appeared to inhibit the identification of words - at least, when the target words were relatively low in frequency and when the mismatching letter was in the middle. Perea and Pollatsek interpret their data in terms of an inhibitory effect occurring at a later stage in lexical access, but it is necessary to emphasise the fact that this was not *single* word naming. The more isolated a word is in terms of orthographic neighbourhood, the more the speed of naming would depend on the activation level of the stimulus word itself.

There are other problems with using neighbourhood measurements in terms of Coltheart et al.'s (1977) initial definition. As Perea (1998) points out, another concern is that there is no differential weight in the letter mismatch between pairs of neighbouring words so although, for example, *story* and *stock* are neighbours of *stork*, one member of the pair has the differing letter at the end and with the other it occurs on the interior. Using a priming technique to enhance the effects of competitiveness among orthographic neighbours in visual word recognition, Perea found that only orthographically related pairs where the prime differed from the target by the third or fourth letter showed inhibitory effects compared to an unrelated word condition. This has implications for current models of word recognition such as Rumelhart and McClelland (1982), Paap et al. (1982) and Grainger, O'Regan, Jacobs, and Segui (1992) which suggest that letter position plays a vital rôle in visual word recognition. Grainger and Segui's (1990) findings suggest that neighbours differing by internal rather than external letters are more competitive than those which differ by the initial letter and Perea and Gotor (1994) report stronger inhibitory effects when the related neighbour was differed by the third rather than the first letter. These are all considerations which require attention when calculating orthographic and phonological neighbours, but since the measurement is used here to investigate across languages as well as within them and as a count of all possible neighbours of each item within each language, it should suffice to use Coltheart et al.'s initial index as an approximation.

1.7.3. Frequency

Many studies reporting frequency effects in word naming latency exist (e.g. Monsell, Doyle & Haggard, 1989; Savage, Bradley & Forster, 1990) with higher frequency words typically being named faster than low frequency words because more frequent words tend to be shorter, contain phonemes that are easier to pronounce or are more practiced (Landauer & Streeter, 1973). The effect of word frequency is greater in word naming than it is in lexical decision tasks (Forster & Chambers, 1973; Frederiksen & Kroll, 1976; Hudson & Bergman, 1985). This has been explained by the claim that the effects observed in lexical decision are as a result of task-specific processes rather than with word recognition per se (Grainger, 1990; Balota & Chumbley, 1984; McCann, Besner & Davelaar, 1988). McRae, Jared and Seidenberg (1990) found that the magnitude of the frequency effect was larger for immediate than for delayed word naming. This is consistent with Jescheniak and Levelt's (1994) findings of a frequency effect on immediate but not delayed naming in a comparison of immediate- and delayed-naming speeds for high- and low-frequency object names. As with most of these studies investigating word frequency, however, age of acquisition was not controlled, and Jescheniak and Levelt now acknowledge (Levelt, Roelofs & Meyer, 1999) that their frequency effect may have occurred as a result of not controlling for age of acquisition, since most of their low frequency words were also later acquired.

1.7.4. Age of Acquisition

In a study also taking into account effects of word length and familiarity, Gilhooly and Logie (1981) still found effects of age of acquisition on word naming latencies. Similar findings were established by Gilhooly (1984) who found AoA to be more important than length of word residence time in memory even when length, familiarity and subjects' vocabulary size was taken into account. Brown and Watson (1987) found that mean word naming latency correlated most highly with AoA and in a simultaneous multiple regression analysis, only AoA displayed a significant independent effect. They deduce that AoA is a better predictor of word naming latency than spoken word frequency, written word frequency and rated familiarity amongst other variables. V. Coltheart, Laxon and Keating (1988) conclude that AoA is a major determinant of reading accuracy and any effects of imageability are attributable to this variable. Using sets which were matched on AoA, length and frequency, they found effects of AoA in word naming by nine-year-old children whilst effects of imageability occurred only for the poor readers in the same sample (it is interesting to note that the study used adult ratings for AoA). Repeated effects of AoA without imageability occurred with adults' word naming. Morrison and Ellis (1995) contrasted the effects of frequency and AoA on word naming and found effects of AoA for sets matched on frequency but no effects of frequency for sets matched on AoA. They also found effects of AoA on immediate but not delayed naming reaction times but no frequency effects on immediate or delayed naming when AoA was controlled. In replications of these experiments, Gerhand and Barry (1998) report effects of both frequency and AoA in immediate word naming and no effect of either variable in delayed naming for words matched on age of acquisition.

Since the two variables of AoA and frequency are related, interest has focused on the fact that the occurrence of word frequency effects might result from confounded effects of the variable with AoA. Words that are acquired earlier in life tend to be more common and those learnt later tend to occur less frequently. The AoA findings (e.g. Morrison & Ellis, 1995) demonstrate that despite this high correlation the two yield different effects depending on the task in hand and frequency effects often arise in studies which ignore the whole topic of age of acquisition (e.g. Jescheniak & Levelt, 1994; Levelt, Schriefers, Vorberg, Meyer, Pechmann & Havinga, 1991).

1.8. Reading in Italian and Similar Languages

In turning to reading in transparent languages, the main issue is how having a shallow orthography might affect how that language is read aloud. With regards to monolingual English word reading, Rastle and Coltheart's (1999) dual-route model proposes that in reading, there exists a lexical, rule-based route and a non-lexical route which operates on the basis of grapheme-phoneme correspondence, bypassing access to the phonological and orthographic lexicons. The dichotomy between the lexical and non-lexical routes holds implications for readers of a regular language. The high grapheme-phoneme correspondence renders it possible for words to be read aloud successfully using the non-lexical and rule-based route, with little or no involvement from the phonological and orthographic lexicons. The rule-based approach is necessary for reading aloud in English, however, given that its orthography has 26 letters mapping onto around 42 phonemes. In English, spellings represent the morphological structures of a word as adhere to a consistent representation of surface phonemes, or whether they deviate from representing the phonetic level in order to conserve deeper morphological information that is obscured in the phonetic surface of speech. For example, if English were to consist of a phonologically shallow orthography, forms such as 'dogz' and 'cats' would be plausible, indicating phonetic variation which is predictable at the cost of obscuring the pluralising morpheme. In English (and other languages such as French), a word's morphemic structure is not clearly signalled its phonemic form, whereas languages such as Turkish have a very clear morphemic structure (Henderson, 1984). In regular languages such as this, there are very few exception words, and existing (i.e. familiar) words, new words and non-words may all be named successfully with the application of grapheme-phoneme correspondence alone.

1.8.1. Differences Between the Reading of Deep and Shallow Orthographies

Since the reading of regular languages like Spanish and Italian is relatively simple in comparison to irregular languages such as English, one possibility is that the amount of cognitive skill required to obtain efficient word recognition is less for Italian and Spanish than it is for English, given the stronger degree of association between a visual array and its phonological representation.

Manrique and Signorini (1994) conducted a study on Spanish reading comparing children at nursery age with children in their first year at school. They found that the ability to partake in phonemic segmentation develops early for Spanish readers, so children can master letter-sound correspondences early on in life and are good at spelling. These children develop analytical skills as a result of facilitative effects of the language's characteristics in terms of structure and orthography.

In an investigation of Spanish word reading abilities in Spanish-speaking children in their first and third school year, Signorini (1997) compared the performance of skilled and less skilled readers across a number of tasks to assess phonological recoding ability, grapheme-phoneme correspondence and phonemic awareness. These tasks included pseudoword reading, reading words with different stress patterns, phoneme deletion and identification of embedded phonemes. It was found that there was a reliance on phonological recoding strategies in the process of becoming a skilled reader of Spanish. The less skilled readers depended on letter-sound knowledge, and spelling-sound correspondences were the main source of information used by both skilled and less skilled readers. The problems in the less skilled readers were as a result of an inability to master the letter-sound correspondences which, in the skilled readers, allowed for good phonological reading abilities and ensured efficient reading strategies. Signorini concludes that word reading strategies during early stages of acquisition of Spanish are strongly biased towards the phonological processes at the letter string, given the phonetic and orthographic characteristics of the language.

Turning more towards comparing English and Italian readers, Cossù, Shankweiler, Liberman, Katz and Tola (1988) found that Italian children performed more accurately than English children on tasks involving phonological segmentation. Italian children showed an improvement in phonemic segmentation performance from nursery age to first-year schooling age in comparison to English children. Similarly, Cossù, Shankweiler, Liberman and Gugliotta (1995) conducted an investigation into patterns of reading errors first- and second-year Italian school children with pre-existing findings on English children, and found that spatially related errors (e.g. confusing *b* and *d*) were of a minor proportion in Italian, but not with English children. Beginning readers of Italian made more consonant than vowel errors, but the opposite was found for English children at the same schooling level. These studies conclude that different orthographic systems provide differences in the phonological processes related to reading; in this case, learning to read a regular orthography facilitates phonemic awareness of words. The consistency of grapheme-phoneme correspondences account for the differences in quantity and distribution of errors across the two languages.

1.8.2 Factors Affecting Speeded Word Naming in Italian and Spanish (Or: The Universality of the Dual Route Model)

In a study which demonstrates the universality of the dual route model even for transparent orthographies, Defior, Justicia and Martos (1996) investigated the effect of the variables of lexical category, word frequency, syllabic structure and word length in the acquisition of reading in Spanish normal and poor speakers. Lexical category referred to words, pseudowords and non-words. For frequency, the authors divided their stimuli into lists of high, medium and low frequency as taken from the Dictionary of the Frequencies of the Usual Vocabulary for Spanish Children (Justicia, 1994). Syllabic structure referred to the manipulation of consonants and vowels within a word, which the authors did at seven levels, and word length was measured in terms of syllables, ranging from 1 to 4+ syllables.

Taking the percentage of correct responses as a dependent variable, the authors found effects of all four variables. More real words than pseudowords or non-words, a greater number of high frequency than medium or low frequency words, and more shorter words were read correctly. Also, different syllabic structures produced different numbers of reading errors. This is not surprising for the Spanish language - as Defior et al. note, there is a strong relationship between the level of difficulty of a syllabic structure and its level of frequency within the language. Poor readers were quantitatively, not qualitatively, different to the normal readers, making more incorrect responses to non-words and pseudowords than to real words, more incorrect responses to longer words and less frequent and more syllabically complex words. The authors interpret their results to mean that the reading mechanisms proposed by dual route modes operate in the same way for transparent as for opaque languages. However, given that the dependent variable taken here was error rate rather than reading reaction time, further experimental evidence is required for this claim.

A further prediction by the orthographic depth hypothesis is that semantic priming and degradation will interact in an orthographically deep language, but not in a shallow language. Previous findings from Serbo-Croatian (Feldman & Turvey, 1983; Lukatela & Turvey, 1987) had concluded that in shallow orthographies lexical access relies solely on the phonological route. Although semantic priming had been found for naming in at least two languages with a deep orthography (English or Hebrew, Frost, Katz & Bentin, 1987), it was absent in Serbo-Croatian (Katz & Feldman, 1983) which has a shallow orthography, but present for word naming in all three languages. In English, lexical decision and pronunciation times were slower when words were presented in a visually degraded form than when they were presented in a semantically related context (Becker & Killion, 1977, Neely, 1991). The effects of degradation and context were found to be interactive, with the benefits of semantic priming to occur more for degraded words than for normally presented ones. However, Lukatela and Turvey found that in Serbo-Croatian degradation and semantic context resulted in additive than interactive effects. These results were consistent with Serbo-Croatian words undergoing phonological conversion prior to lexical access and degradation being restricted to this pre-phonological stage, having no influence on lexical access per se, so a related semantic context affected normal and degraded stimuli equally.

Bajo, Burton, Burton and Cañas' (1994) study compared English and Spanish participants in their performance on a lexical decision task, with word pairs controlled for length and frequency. If lexical access in languages with shallow orthographies were to depend more on pre-lexical phonological conversion than deep orthographies, then stimulus degradation and context should interact more for English than for Spanish participants. Bajo et al. found that the two factors interacted in the same way for both English and Spanish participants, suggesting, as with Defior's study, that Spanish readers do make use of both routes in reading. However, the authors conclude that the results do not rule out the idea that Spanish participants may be more *flexible* in the reading strategy they use, with the route employed in word reading varying across participants, or even across trials.

In an attempt to shed light on the somewhat varied existing findings of semantic priming, Tabossi and Laghi (1992) investigated whether semantic priming affected word pronunciation in Italian, and whether the conditions under which semantic priming effects occur differ in Italian and English. In a semantic priming experiment involving reading aloud the second word of an associated pair (for which both words were controlled for syllable length and for frequency), semantic priming was found, suggesting that naming occurs prelexically in Italian. Semantic priming effects disappeared when pseudowords were introduced into a list, as it caused the actual words to be produced nonlexically and on the basis of assembly rather than whole-word phonology. Hence, some lexical knowledge was involved in the reading of Italian words. It was found that in English, with its deep orthography, actual words were read consistently through lexical output phonology but given the shallow orthography in Italian, this strategy could be abandoned in favour of nonlexical assembled phonology when word regularity and the introduction of pseudowords rendered that way an efficient and successful one.

The notion that readers of a shallow orthography are able to use two routes of the dual route model was further supported by findings by Sebastián-Galles (1991) examining the reading of pseudowords in Spanish for the existence of lexical (analogous) effects. These had been found initially by Glushko (1979); in the reading of pseudowords American participants did not always follow grapheme-phoneme correspondence, but instead pronounced them in ways which were irregular according to American-English phonology. If Spanish participants relied solely on the grapheme-phoneme correspondence route, lexical effects should not have been present in the reading of pseudowords. However, Sebastián-Galles did find lexical effects similar to those of Glushko. Furthermore, strong semantic priming effects were also found in both lexical decision and naming tasks, again, results which did not support Frost et al. or Katz and Feldman. These results suggest that the differences in adult skilled readers of deep and shallow orthographies are not particularly distinct. One idea by Sebastián-Galles was that although both routes in reading aloud may be accessible to Spanish speakers, a source of variation that may affect reading processing is average length and number of syllables per word. Since Spanish (as well as Italian) has very few monosyllabic words (7.54% of all words including function words for Spanish; Navarro Tomás, 1946) and the average word length is high. Thus, we should expect length effects to exert in naming of these regular languages, in the absence of an effect in English or French - this is consistent with the findings presented so far.

Job, Peressotti and Cusinato (1998) replicated Sebastián-Galles' findings in Italian. They found consistency (i.e. lexical) effects when pseudonyms were mixed with words, regardless of whether the target pseudoword was created to be consistent or inconsistent with the original word it had been created from. However, the lexical effects disappeared when lists of each of the two types of pseudowords were presented by themselves. Again, these results were compatible with readers of a shallow orthography employed both routes of the dual route model.

So far these studies have found effects of length and frequency. Other studies in languages other than English have also examined effects of other lexical variables such as stress and neighbourhoods.

1.8.3. Stress

One source of irregularity which does exist in both Italian and Spanish, is that of lexical stress assignment, which, considering the large amount of literature in reading, has received less attention. The application of conditional rules in this case depends on the knowledge of the reader. Word-specific knowledge is the only way to assign stress reliably in languages where stress is not predictable (Colombo & Tabossi, 1992). In Italian, stress position is not fixed but the most frequent type is on the penultimate syllable. Knowledge of this rule should then provide a bias in responding to new words. Each frequently encountered word should have information specific to it - including stress - directly stored within its phonological representation. Thus, one prediction that could be made is that when a pronunciation is derived by word-specific pronunciations stress marking is directly specified, but if pronunciation were to be computed through sublexical processes, the dominant stress pattern would be applied as a default until the computed output were checked against the correct one. When the temporarily assigned stress is not correct, the two contrasting outputs should produce a delay in pronunciation. When words with a less frequent stress pattern are used, participants might be encouraged to employ a lexical process to retrieve a pronunciation rather than a sublexical assembly process, the output of which would be unreliable. In English, Monsell, Doyle and Haggard (1989) had already found longer naming times for low frequency words with a less common type of stress, but there was no difference in regular or irregular stress in the naming of high frequency words.

Colombo (1992) presented lists of three-syllable Italian words with regular or irregular stress and of a high or low frequency in a naming and a lexical decision task. Faster naming latencies were found for regularly stressed, low frequency words but no difference for the high frequency, which was as predicted. A significant interaction occurred between stress and frequency for errors but not reaction times in lexical decision. Colombo concluded that the location of stress is important in retrieving the phonological information of a word in Italian.

Colombo raised a number of other important issues, one being that neighbourhood consistency is also important for stress assignment. For Italian, the final two syllables are important for the definition of neighbourhood and are be consulted for the location of stress.

1.8.4. Neighbourhoods

Most of the studies on orthographic neighbourhoods have been conducted in languages other than English. Peerman and Content (1995) used French words and pseudowords in word naming tasks. They examined the orthographic and phonological characteristics of neighbourhoods through quantitative analyses of a given word's corpus, for example, by investigating summed neighbours frequency and summed 'friends' and 'enemies' frequencies for stimulus sets varying in frequency. Peerman and Content argued that if the main contribution of neighbourhood size is to accelerate lexical identification, larger effects should be present for pseudowords, as only real words benefit from faster activation of their lexical entry. Also, the beneficial effect of neighbourhood should be less apparent for high frequency words as they have higher resting levels and therefore take less time to reach threshold. However, the authors found that pseudowords and low frequency words were pronounced faster when they were orthographically similar to only a few words, and orthographic neighbourhood size did not contribute to high frequency words. Peerman and Content argue that the facilitatory effect of neighbourhood size is determined by a subset of neighbours - the phonographic string - which are also *phonologically* similar to the target letter string. It is the joined orthographic and phonological similarity between lexical neighbours and the target letter string that determines the facilitation effect.

Grainger (1990) used the Dutch language in lexical decision and word naming tasks and found that when neighbourhood frequency was controlled, the effect of word frequency in lexical decision was comparable to that in naming. According to activation based models, naming latency is determined by activation levels of all activated word representations whose phonology is partly consistent with the target, which implies that neighbourhood size and printed frequency should affect latency in word naming. Grainger found that word naming latencies were facilitated by increasing the number of higher frequency neighbours, and naming responses could be inhibited by prior presentation of an orthographically similar word of a lower frequency than the target. He explains these results in terms of the interdependence of the two routes in the dual route model (Norris & Brown, 1995; Paap et al. 1987; Patterson & Morton, 1985). Spelling-to-sound translation rules facilitate lexically derived phonology. The pronunciation of words that take longer to recognise is facilitated by phonology derived from these rules when the phonology corresponds to the lexically derived phonology (that is, for regular words). Irregular words can only be correctly pronounced by the lexical route and so would show a frequency effect, but as low frequency, regular words would benefit from spelling-to-sound translation rules, the frequency effect for these words would be reduced. In terms of neighbourhoods, Grainger argued that all his stimuli comprised of regular words and so any inhibitory effect was cancelled by the facilitatory operation of the spelling-to-sound translation rules. Hence, no inhibitory effects of neighbourhood frequency were observed for word naming in his experiments.

Carreiras, Perea and Grainger (1997) make the same point. This time studying Spanish participants, they compared performance across a number of tasks. For word naming, it was found that there was an inhibitory effect of neighbourhood frequency for words from a small neighbourhood. Since their Spanish words had consistent pronunciations and were controlled for syllable frequency, they argue that effects of orthographic neighbourhood could not be attributed to variation in phonological consistency. In languages with fairly regular grapheme-phoneme correspondences, such as French or Spanish, the orthographic neighbours of a target word are also phonological neighbours. This is not the case in English, where a given string may have more than one pronunciation. This is important given the speed with which phonological codes may be generated from a pronounceable letter string. As Carreiras et al. point out, many studies on orthographic neighbours have failed to control for phonological neighbours, and this may contaminate the effects of orthographic neighbourhood in languages with relatively inconsistent spelling-to-sound correspondences.

1.8.5. Age of Acquisition

The history of the studies on foreign word naming has mirrored the history of studies of English word naming insofar as the fact that many have examined the rôle of *frequency* as a variable by using pre-existing frequency measures, but hardly any have also taken into account age of acquisition. This is probably due to the fact that, following the study by Morrison, Chappell and Ellis (1997) both rated and objective measures are now widely available for use by researchers in English, but not as many are available in other languages.

Brysbaert (1996) used third year primary school children (8-9 years old) to investigate the effect of word frequency on word naming latency when AoA is controlled in Dutch. Reliable independent effects of both AoA and word frequency were found. However, the AoA measure used in the experiment was a different one to the one employed in English studies. It was taken from a large-scale study conducted by Khonstamm, Schaerlaekens, de Vries, Akkerhuis and Froonincksx (1981) in Dutch-speaking countries. This study involved a representative sample of teachers who were required to estimate which words 6-year-olds should understand - that is, for which did the children have a passive knowledge. For Belgium, for example, 40 teachers of the final year of nursery school and 41 teachers of the first year of primary school were given 6785 words which were rated according to children's knowledge. This was scored by the total percentage of teachers who marked the words as being known - the authors refer to this as the AOAT measure (age of acquisition based on teachers' judgements). A study by van Loon-Vervoorn (1989) reports the AOATs to correlate with student ratings for AoA on an 8-point scale at .87 for 52 verbs and .92 for 44 nouns. However, in Dutch the correlations between AOAT and tabulated frequencies were much smaller than those in English; in this study they ranged from .13 to .33. According to Brysbaert, the problem with this AOAT measure is that it may not be sensitive enough to capture the variance due to AoA, as the AOAT measure relies on measure of 6-year-olds and thus excludes distinctions that are made between words learned between the ages of 1 and 4.

In sum, it is now of importance for researchers to include AoA as a variable in studies which explore word frequency, in order to distinguish between the two variables. The studies mentioned in this section have found effects of word frequency in a number of studies, including Italian and Spanish, but it is unclear how much of this effect could be attributed to other confounding factors such as AoA.

The work in this thesis will examine lexical processing and word production threefold: lexical production by English and Italian native speakers (including Italian grammatical gender), English-Italian bilingual production and the break-down of the bilingual lexicon, by way of a cognitive neuropsychological case study. The next chapter provides an exploratory investigation as to which factors are involved in naming objects and words by native speakers of English and Italian. This will be carried out using multiple regression analyses on the effects of a broad range of independent variables on naming reaction times.

Chapter 2

Picture Naming and Word Reading in English and Italian

2.1. Monolingual Picture and Word Naming

The previous chapter examined studies of which factors affect speed of picture naming and word reading and how they have played an important part in the development of theoretical models. Most of this work has been carried out in English. This chapter presents four experiments in which native speakers of English and Italian named Snodgrass and Vanderwart (1980) and some of the new York (Morrison, Chappell & Ellis, 1997) drawings of familiar objects or read aloud their written names.

Four groups of native speakers of English and Italian named a set of 270 object pictures or read the written names of those objects aloud. Regression analyses were carried out on the mean correct reaction times in each task using a range of predictor variables, obtained separately where necessary from Italian sources. The ability of different properties of the objects and their names to predict naming and reading speed is examined. Predictors include age of acquisition and frequency; also length (in syllables and phonemes) and number of phonological neighbours (i.e. the number of words differing from a given object name by a single phoneme). For the naming experiments, visual complexity of the pictures and familiarity of the objects were included as factors, and for the word naming experiments, letter length and number of orthographic neighbours were included as additional predictors. For each experiment, some of the items were removed due to being heterophonic in reading (e.g. bow), but especially because of low name agreement. Therefore, a fresh correlation matrix and separate multiple regression analyses are presented for each task and language to reflect the consequences of jettisoning items on each occasion. The same items were used as a starting point for all four experiments.

Experiment 1

English Object Picture Naming

Method

Participants. The participants were a group of 20 English native speakers aged between 19 and 33 years (mean age = 25 years) from the University of York. Subjects were paid £4 or given a course credit for taking part. None of the participants were bilingual.

Materials. The experimental stimuli were the set of 270 black and white pictures from the Snodgrass and Vanderwart (1980) and York picture sets (Morrison, Chappell & Ellis, 1997). The predictor variables were: visual complexity, object familiarity, name agreement, word frequency, age of acquisition, phonological neighbours and length. Wherever possible, the existing ratings were used from Morrison et al. (1997).

2.1.1. English Ratings of the Snodgrass and Vanderwart and York Pictures

Visual complexity. The English measures from Morrison et al. were used. These had been obtained by asking participants to rate the complexity black-and-white drawings from 1 = *very simple* to 5 = *very complex.*

Concept familiarity. Barry, Morrison and Ellis (1997) obtained measures for this variable by giving participants the pictures at random and asking them to judge each one with regards to how often they came into contact with, or thought about the object depicted. Each picture was rated on a 5-point scale, where 1 = *very unfamiliar* and 5 = *highly familiar*. These data were used in the present experiment.

Name agreement. For the purposes of this study, name agreement is taken to mean the extent to which participants agree on the chosen name for a picture. For English name agreement, Morrison et al. took their measure by asking participants to write the 'usual name' for each line drawing. Name agreement is therefore the percentage of participants who wrote the target name. In this study, name agreement was taken to mean the percentage of participants who identified each picture by its correct (target) name. All items with name agreement of 65% or less were removed from all of the analyses. That is, each item included in the analyses had been named correctly by at least 13 of the 20 participants.

Frequency. It is important to distinguish between the frequency of a word in printed matter and its frequency in speech. In English, it is possible to make this distinction, given the many frequency corpora that are available. Five measures of word frequency were used for the English data and care was taken to ensure that the appropriate measure was used for the regression analyses.

The five measures of English frequency were: (a) a measure of the frequency of the printed object names from the Celex database (Baayen, Piepenbrock & Van Rijn, 1993) (b) a measure of spoken word frequency taken from the Celex database and (c) a combined written and spoken frequency of the object names from the Celex databases. These Celex measurements are based on a more modern and larger corpus of British English, with the spoken frequency database sampling 1,300,000 words (Sinclair, 1987). The other two English frequency measures were (d) the standard Kucera and Francis (1967) American corpus of printed word frequency and (e) the rated word frequency measure from Morrison et al. where raters were asked to estimate the frequency with which the object names were encountered either in speech or writing. The reason for including this measure of frequency was for the same reason Morrison et al. did - to control for the fact that word learning age is typically measured on a fixed point scale; and to avoid comparing this to an objective measure of frequency only. Rated frequency was measured on a scale from 1-5 where 1 = *less than once a year* and 5 = *at least once a day*. As with these previous studies, frequency was transformed using the formula log $(1 + x)$ to reduce skew.

Age of acquisition. Two measures of age of acquisition were used for the English analyses, both of which were from the Morrison et al. investigation. They obtained an objective age of acquisition measure derived in a large scale study of British children aged between 2 years 6 months and 10 years 11 months. The children named the Snodgrass and Vanderwart and York pictures and each picture was given its objective age of acquisition in months. One of the methods employed to calculate objective word learning age was termed the '75% rule' which was the age at which 75% of children at a given age group knew the name for an object. The second, a rated measure was derived by giving raters the object names with a 7-point scale beside each word. This scale ran from 1 = *learned at the age of 0-2 years* to 7 = *learned at the age of 13 or over*. Raters estimated the age at which they believed they had learned the spoken or written form of the word. The two measures correlated at .759.

Word length. Two measures of word length were calculated for the English object names. Firstly, the number of phonemes per word was measured as pronounced in standard Southern British English, and secondly, word length was expressed in terms of syllables.

Neighbourhoods. To date, neighbourhood measures have not been included as a variable in analyses of object naming latencies. Phonological neighbours was included as a variable for both languages. This was calculated using the definition by Coltheart, Davelaar, Jonasson and Besner (1977) for creating orthographic neighbours, but using phonemes instead of letters. The *phonological* neighbours were calculated to the definition of them being the number of words that can be created by altering one phoneme of the stimulus word whilst preserving phoneme positions, ignoring the spellings. For example, *beef, laugh,* and *lean* are all phonological neighbours of *leaf.* Additions (e.g., *car* - cart) and omissions (*dice* - ice) and proper names were not included as neighbours. Standard southern British English was used, and all neighbours were checked using the Oxford Encyclopaedic Dictionary (1995).

Procedure. Each picture was presented for 2500 ms using the PsyScope package (Cohen, MacWhinney, Flatt & Provost, 1993) on an Apple Macintosh Mac Centris computer. A fixation point was shown for 1000 ms and was offset 50 ms prior to stimulus onset. Vocal reaction times were measured from the onset of the stimulus. Each picture was positioned in the centre of the screen. Participants wore headphones with a high-sensitivity microphone attached. The microphone picked up the participant's initial response, which triggered a voice key. There was then an interval of 500 ms before the next fixation dot appeared, which was followed 1000 ms later by the next item. Responses were recorded to the nearest millisecond. The items were presented in a fixed random order to all 20 participants, and the instructions were as follows:

In a few moments, you will see a series of objects. You must give the English name for each object. Try not to hesitate, to respond as quickly as possible and to give the first word that you think of. Press the mouse to continue.

Participants were tested individually in sessions lasting around 30 minutes. After the participant had put on the headphones and sat at a comfortable distance from the computer screen (s)he was required to say a few words while the sensitivity of the voice key was adjusted.

An initial practise phase of 6 trials took place with the items *sun, piano, bath, dice, whale* and *purse* to familiarise participants with the procedure. If the participant felt (s)he understood the procedure and was ready to begin the experiment proper then the 310 test trials began. These were arranged in four blocks of around 80 items, 10 of which were practice items in each block (so 40 of the 310 pictures were practise items) and whose reaction times were omitted in the analyses. The presentation of blocks was counterbalanced. If the participant did not feel comfortable with the task the practice sessions were repeated. Participants were given a short break in between each block. While the items were being named, the experimenter noted any hesitations or deviations in naming from the exact target, which were also removed from the analyses.

Results

Reaction times to practise items were removed and the mean of the participants' RTs was calculated for each remaining picture. Responses that involved the production of a name other than the target were omitted from the calculation of the means. False triggerings of the voice key, or voice key failures in picking up onset times on trials were also omitted from the calculation of the means, as were responses below 400 ms and above 2500 ms.

Of the original 270 items, 89 items for which fewer than 65% of subjects (13 out of 20) produced the target name were excluded from further analysis. This left 181 English items for analysis. Of these items, a total of 19.6% of reaction times did not contribute to the means: 4% were due to recording failures, 14.4% were due to naming errors and 1.2% were not computed because participants took less than 400 ms or more than 2500 ms to respond.

The mean of the naming times for these 181 items was 935 ms (SD = 147.30, range = 682 - 1391 ms). A correlation matrix showing the relationship between the dependent variable of English mean naming time and the 13 independent variables for these 181 English items used in the analysis is shown in Table 2.1. The variables which correlate most highly with naming time are objective AoA (.657), followed by rated AoA (.533). The familiarity and five frequency measures correlated with naming latency to a similar degree - of the frequency measures, rated frequency had the highest correlation at -.383. Familiarity correlated with naming time at -.376. There was very little difference between each of the Celex correlations: Celex spoken frequency correlated at -.373, Celex combined frequency at -.371 and Celex written at -.368. The frequency measure from Kucera and Francis closely followed, with a correlation of -.314.

Howell (1992) points out the importance of not including more than one measure of the same thing in a simultaneous multiple regression since it is important to be able to examine the *unique* contribution of each variable to the prediction of the independent variable. For this reason, a number of simultaneous multiple regression analyses were carried out using mean naming time as the dependent variable. In each analysis, one of the five different frequency measures was combined with one of the two AoA measures and with one of the two length measures. Hence, there were 7 independent variables in each analysis: (a) visual complexity, (b) familiarity, (c) one of the measures of frequency, (d) name agreement, (e) one of the measures of AoA , (f) phonological neighbours, and (g) one of the

Table 2.1.

Correlation Matrix for All the Variables in Experiment 1 - English Picture Naming (n=181)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. English Picture Naming RT	-	.533**	.657**	-.373**	-.368**	-.371**	-.314**	-.383**	.211**	-.376**	-.175*	-.196**	.204**	.226**
2. English Rated AoA		-	.782**	-.487**	-.558**	-.555**	-.481**	-.583**	.227**	-.545**	-.227**	-.320**	.382**	.455**
3. English Objective AoA			-	-.452**	-.491**	-.492**	-.382**	-.515**	.180*	-.428**	-.270**	-.235**	.240**	.285**
4. Celex Spoken Frequency				-	.878**	.884**	.776**	.549**	-.125	.496**	.160*	.336**	-.353**	-.387**
5. Celex Written Frequency					-	.999**	.859**	.634**	-.225**	.588**	.211**	.388**	-.424**	-.456**
6. Celex Combined Frequency						-	.859**	.634**	-.221**	.588**	.209**	.384**	-.418**	-.449**
7. K-F Frequency							-	.552**	-.248**	.493**	.202**	.444**	-.444**	-.500**
8. Rated Frequency								-	-.371**	.892**	.082	.255**	-.271**	-.317**
9. Visual Complexity									-	-.383**	-.084	-.239**	.152*	.190**
10. English Familiarity										-	.107	.190**	-.269**	-.292**
11. English Name Agreement											-	.077	-.180*	-.210**
12. English Phon Neighbours												-	-.635**	-.670**
13. English Syllable Length													-	.864**
14. English Phoneme Length														-

* *p* <.05

** *p* <.01

K & F Freq = Kucera & Francis Frequency

Eng Phon Neighbours = English Phonological Neighbours

Table 2.2.

English Picture Naming Summary

	English Picture Naming (n=181)																			
Visual complexity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
English concept familiarity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	✓	✓	✓	✓
English Celex combined frequency	X	X	X	X	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
English Celex spoken frequency	•	•	•	•	X	X	X	X	•	•	•	•	•	•	•	•	•	•	•	•
English Celex written frequency	•	•	•	•	•	•	•	•	X	X	X	X	•	•	•	•	•	•	•	•
English K-F written frequency	•	•	•	•	•	•	•	•	•	•	•	•	X	X	X	X	•	•	•	•
English rated frequency	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	X	X	X	X
English objective AoA	✓	✓	•	•	✓	✓	•	•	✓	✓	•	•	✓	✓	•	•	✓	✓	•	•
English rated AoA	•	•	✓	✓	•	•	✓	✓	•	•	✓	✓	•	•	✓	✓	•	•	✓	✓
English name agreement	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
English phonological neighbours	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
English syllable length	X	•	X	•	X	•	X	•	X	•	X	•	X	•	X	•	X	•	X	•
English phoneme length	•	X	•	X	•	X	•	X	•	X	•	X	•	X	•	X	•	X	•	X

✓ = significant independent effect ($p < .05$) in simultaneous multiple regression
X = no significant independent effect in multiple regression
• = variable not entered into this analysis

measures of length. Table 2.2 summarises the results of the analyses. Each column represents the results of a different multiple regression analysis. For example, the first column represents the results of the analysis employing visual complexity, concept familiarity, Celex combined frequency, objective AoA, name agreement, phonological neighbours and syllable length; whereas the second column represents the results when phoneme length was used instead of syllable length, and the fifth column represents the results when Celex spoken frequency was employed in place of Celex combined frequency.

In each analysis, the overall regression was always significant (p <.001) . The analysis giving the best F and R^2 was the one employing objective AoA, rated frequency and syllable length (R^2 = .455, F = 21.231, p <.001). The smallest proportion of variance accounted for was .552. Table 2.3 shows the analysis employing the best combination of variables. Only one variable stood out as having a significant independent effect on picture naming speed, this was the age at which the picture was acquired. This variable of AoA was significant regardless of whether the objective or rated measure was employed. Marginal effects of familiarity emerged with rated frequency. Variables showing no significant effect were: visual complexity, frequency, name agreement, phonological neighbours and length.

Discussion

The results of the English picture naming experiment indicate that the variable that has the most reliable independent effect on the amount of time it takes to name a picture is the age at which that picture's name is acquired. This is regardless of whether AoA is measured by adult raters, or whether the measurement is obtained as an objective measure from children of various ages. The frequency of usage of an item's name in the English language has

Table 2.3.

Simultaneous Multiple Regression Analysis of Experiment 1 with Naming Latency as the Dependent Variable, Using Objective AoA, Rated Frequency and Syllable Length

	Regression Coefficient	*Standard Error*	*ß Coefficient*	*t*
Visual complexity	12.032	10.676	.069	1.127
Rated familiarity	-38.483	18.895	-.257	-2.037*
Rated frequency	37.281	23.509	.210	1.586
Name agreement	22.976	74.047	.018	.310
Age of acquisition	3.281	.349	.638	9.410**
Phonological Neighbours	-.432	1.221	-.026	-.354
Syllable length	2.817	14.447	.015	.195

* $p < .05$
** $p < .01$

no effect on how fast that name is produced, as shown by the use of four objective and one rated measure of frequency employed in the analyses. The finding of an effect of AoA on picture naming latency replicates the original studies by Carroll and White (1973); Lachman (1973); Lachman et al. (1974) and Gilhooly and Gilhooly (1979); as well as the more recent findings by Morrison, Ellis and Quinlan (1992); Morrison and Ellis (1995); Barry, Morrison and Ellis (1997) and Ellis and Morrison (1998). The data are also in accordance with Carroll and White (1973); Gilhooly and Gilhooly (1979); Morrison, Ellis and Quinlan (1992) and Morrison and Ellis (1995) in finding no independent contribution of word frequency in picture naming latency.

The emergence of marginal familiarity effects when rated frequency was the employed measure of frequency, reflects the natural correlation between how often an item is seen (concept familiarity) and how often its name is used (word familiarity) - a correlation of .892 in this study. This also replicates findings by Oldfield (1966) and Rochford and Williams (1965). The absence of familiarity effects when one of the other four measures of frequency was employed, reflects (but does not support) Brown and Watson's (1987) argument that rated familiarity could be confounded with experiential frequency.

Experiment 2

Italian Object Picture Naming

Method

Participants. The participants were a group of 20 native speakers of Italian aged between 19 and 31 years (mean age = 26 years) who had been in the UK for less than three months and had arrived at the University of York for postgraduate study. None of the participants considered themselves to be bilingual. Each participant was paid £4 for taking part.

Materials. The stimuli were the same set of 270 black and white pictures from the Snodgrass and Vanderwart (1980) and York picture sets (Ellis & Morrison, 1997) as in Experiment 1. The variables looked at were as Experiment 1: visual complexity, rated familiarity, name agreement, frequency, age of acquisition, phonological neighbours and length, but Italian ratings were obtained for each picture and its name from at least 20 Italian native speakers where this was necessary to provide Italian equivalents of the measures.

2.1.2. *Italian Ratings of the Snodgrass and Vanderwart and York Pictures*

Visual complexity. As this is a non-linguistic variable, the measure from Morrison et al. was re-employed as in the previous experiment.

Concept familiarity. Data were collected for the Italian measurement of this variable in the same way as for the English measurement, on a separate occasion to the experiment proper. Twenty-two participants were asked to rate the same drawings for the degree to which they come into contact with or think about the concept on a scale from 1 = *unfamiliar* to 5 = *very familiar*. These instructions were in Italian.

Name agreement. Name agreement is the extent to which participants agree on the chosen name for a picture. Italian name agreement measures were obtained by taking the number of participants in this experiment who agreed on an item's name. Any items with less than 65% name agreement were omitted from the analyses.

Frequency. Although there were five measures of word frequency available for the English version of this experiment, which rendered it possible to make the distinction between written and spoken word frequency, for Italian only two frequency measurements were available. The first was a written frequency measure taken from a corpus of 500,000 words by Bortolini, Tagliavini and Zampolli (1971). The Italian measure was transformed using the formula $\log(1 + x)$ in order to reduce skew. The second was a rated measure, the data for which were obtained in the same manner as for the English version. Rated frequency values for 295 items were obtained via a questionnaire. Twenty-two raters were asked to estimate the frequency with which they thought an Italian native speaker in Italy encountered the words either in speech or writing, on a scale from 1 to 5, where 1 = *less than once a year*, 2 = *more than once a year but less than once a month*, 3 = *more than once a month but less than once a week*, 4 = *more than once a week but* *less than once a day*, and 5 = *at least once a day*.

Age of acquisition. Two measures of age of acquisition were used for the English analyses, and both of these were from the Morrison et al. study. They obtained an objective age of acquisition measure as well as a rated measure. The latter was derived by giving 22 raters the object names with a 7-point scale beside each word. This scale ran from 1 = *learned at the age of 0-2 years* to 7 = *learned at the age of 13 or over*, and raters estimated the age at which they believed they had learned the spoken or written form of the word. Italian ratings were obtained in a similar fashion, with the only differences were that the picture of the object was presented alongside the Italian object name and, of course, that the instructions and wording were in Italian. There were 317 items presented in all to 22 Italian participants.

Word length. Two measures of word length were calculated for the Italian picture names. These were number of phonemes and number of syllables per word. Italian words tended to be longer than the English words (ranges = 2-15 letters for Italian words and 3-11 letters for English words).

Neighbourhoods. Both orthographic and phonological neighbours were included for the Italian items. Again, the definition of orthographic neighbours was taken to mean the number of words that can be created by changing one letter of the stimulus word, whilst preserving letter positions and length as according to the definition by Coltheart et al. An Italian example of this is: *caso, viso, vago* and *vasi*, which are all real words and orthographic neighbours of *vaso*. Again, additions (which are somewhat infrequent in Italian, given that most nouns end with vowels), omissions (*vago* - ago) and proper names were not included as neighbours.

One problem encountered in calculating neighbourhood measurements in Italian, is the words are longer than in English and so are likely to have fewer orthographic neighbours. This makes it difficult to control for neighbourhoods across the two languages. To an extent, the difference is compensated for by the nature of Italian nouns. Most Italian nouns will have at least one neighbour, by the sheer nature of how nouns are created. In Italian, a plural is produced by altering the last letter of a noun; so nouns ending with '-a' in the singular change their ending to '-e' in the plural (*porta* becomes *porte*), those ending with '-o' or '-e' in the singular change to an '-i' ending in the plural (*libro* becomes *libri* and *elefante* becomes *elefanti*). The exceptions to this rule are where nouns end in the cluster '-co' or '-ca'. These endings change to '-chi' or '-che' (*arco* becomes *archi* and *barca* becomes *barche*). and some nouns ending in '-go' and '-ga' change their endings to '-ghi' or '-ghe' in the plural (e.g., *drago* becomes *draghi*).

For the *phonological* neighbours, changes like those from *drago* to *draghi* could be included. These were calculated in the same manner as the English phonological neighbours: to the definition of them being the number of words that can be created by altering one phoneme of the stimulus word whilst preserving phoneme positions, and the measures were checked by native speakers of Italian. Orthographic and phonological neighbours were almost always confounded since Italian has a strong grapheme to phoneme correspondence. All neighbours were also checked in the Collins English-Italian Italian-English Dictionary (1995).

Procedure. The procedure was exactly the same as for Experiment 1 with each picture presented for 2500 ms using the PsyScope package on the same computer, a fixation point was shown for 1000 ms, offset 50 ms prior to stimulus onset and reaction times were measured from stimulus onset. Participants wore the same headphones with a high-sensitivity microphone attached which picked up the subject's initial response, triggering a voice key. There was then a 500 ms interval before the next fixation dot which was followed 1000 ms later by the next item. The items were presented in a fixed random order to all 20 subjects and these instructions were presented:

Fra qualche minuto vedrai una serie di oggetti. Devi dare il nome italiano di ogni oggetto e di dire la prima parola che ti viene in testa, il più veloce possibile, e senza esitare. Premi il mouse per continuare.

(In a few minutes you will see a series of objects. You must give the Italian name for each object and to say the first word that comes into your head as quickly as possible, without hesitating. Press the mouse to continue).

Participants were given the same initial practise phase of 6 trials as in Experiment 1 to familiarise themselves with the procedure. Once the procedure was clear, the experiment proper began with the presentation of 310 test trials arranged in four blocks of around 80 items, of which 10 in each block were practice items and whose reaction times were omitted in the analyses. Practice sessions were repeated if the participant did not feel comfortable with the task. Once more, the experimenter noted any hesitations or deviations in naming from the exact target whilst participants were naming the items and these were removed from the analyses.

Results

As with the previous experiment, the participants' mean reaction times for each picture were computed, and responses where participants gave a name other than the most commonly produced were excluded from the calculation of the means. Examples of these are alternative names (*barile* - 'botte' [barrel] *scarafaggio* - 'scarabeo' [beetle]), semantic errors (*capanna* [barn] - 'fattoria' [farm]), visual errors (*recinto* [fence] - 'cancello' [gate]) or semantic and visual (*anatra* [duck] - 'oca' [goose] *jelly* - 'tiramisù'). False triggerings of the voice key, or voice key failures in picking up onset times on trials were also omitted from the calculation of the means, as were responses below 400 ms and above 2500 ms.

Of the original 270 experimental items, 87 were excluded from further analysis. Seven were removed because they names comprised of more than one word (*uomo di neve* [snowman] *ferro da stiro* [iron]); 4 were removed because the items had 'borrowed' English names (e.g., *yo-yo, wigwam, cowboy, jelly, toast*); 4 because the pictures depicted the English versions of the objects in question and so the pictures were unfamiliar to Italian participants (*sandwich, kettle, plug* and *biscuit*). This resulted in these items being named incorrectly by Italian participants. A further 72 items were removed because fewer than 13 of the Italian participants named them correctly (this included the use of dialect names and diminutives such as *campanella* for campana [bell] and *limetta* for lima [nail file]).

The remaining 183 items therefore had at least 13 correct responses from the total of 20 participants (65% name agreement). In addition, from this remaining set of 183 items, 27% of responses did not contribute to the means. Of these, 8.6% of individual RTs were omitted because of recording failures, 16.6% because a naming error was made, and 1.8% because participants took less than 400 ms or more than 2500 ms to respond. The mean of the naming times for these items was 1035 ms (SD = 144, range 787 - 1433).

Table 2.4 shows the correlations between naming RTs for the set of 183 items and the 9 predictor variables. The variables which correlate most highly with naming latency are name agreement (-.526) and age of acquisition (.438). It is interesting to see from this table how some independent variables correlate with each other; for instance, the highest correlation of all is between syllable length and phoneme length (.874).

Table 2.4.

Correlation Matrix for All the Variables in Experiment 2 - Italian Picture Naming (n=183)

Variable	1	2	3	4	5	6	7	8	9	10
1. Italian Object Naming RT	-	.438**	-.340**	-.317**	.220**	-.273**	-.526**	-.115	.082	.100
2. Italian Rated Age of Acquisition		-	-.535**	.438**	.300**	-.486**	-.260**	-.255**	.197**	.235**
3. Italian Written Frequency			-	-.340**	-.166*	.434**	.196**	.255**	-.236**	-.257**
4. Italian Rated Frequency				-	-.414**	.797**	.116	.133	-.106	-.074
5. Visual Complexity					-	-.456**	-.023	-.166*	.179*	.218**
6. Italian Concept Familiarity						-	.006	.065	-.053	-.047
7. Italian Name Agreement							-	.082	-.074	-.119
8. Italian Phonological Neighbours								-	-.428**	-.487**
9. Italian Syllable Length									-	.874**
10. Italian Phoneme Length										-

* p <05

* * p <01

Multiple regression analyses were performed with the mean naming time as the dependent variable and with seven independent variables. The independent variables were: (a) visual complexity, (b) familiarity, (c) either written or rated frequency, (d) name agreement, (e) rated AoA, (f) phonological neighbours and (g) either syllable or phoneme length. Naturally, for all Italian regression analyses reported here, the Italian versions of ratings were used for each variable.

Table 2.5 summarises the results of the analyses when multiple regression analyses were carried out with each of the length and frequency measures. Thus, each column represents the results of a different multiple regression

Table 2.5.

Italian Picture Naming Summary

	Picture naming (n=183)	
Visual complexity	X	X
Italian concept familiarity	X	X
Italian rated frequency	X	X
Italian written frequency	X	X
Italian rated age of acquisition	✓	✓
Italian name agreement	✓	✓
Italian phonological neighbours	X	X
Italian syllable length	X	•
Italian phoneme length	•	X

✓ = significant independent effect ($p < .05$) in simultaneous multiple regression

× = no significant independent effect in multiple regression

• = variable not entered into this analysis

analysis. In each analysis, the overall regression was always significant (p <.001). The analysis to give the best F and R^2 was the one employing written frequency and phoneme length, with values of R^2 = .404, F=16.981, p <.001. The results of this are shown in Table 2.6. The smallest proportion of variance accounted for was .631. Only the effects of AoA and name agreement reached significance regardless of whether written or rated frequency was used or whether length was measured in syllables or phonemes.

Table 2.6

Simultaneous Multiple Regression Analysis of Experiment 2 (Picture Naming) with Naming Latency as the Dependent Variable using Written Frequency and Phoneme Length

	Regression Coefficient	*Standard Error*	*ß Coefficient*	*t*
Visual complexity	17.663	11.521	.104	1.533
Rated familiarity	-9.095	8.614	-.081	-1.056
Written Frequency	-26.195	19.039	-.101	-1.376
Name agreement	-699.370	94.460	-.455	-7.404**
Age of acquisition	53.250	19.789	.207	2.691**
Phonological Neighbours	3.9E-02	4.238	.001	.009
Phoneme length	-3.694	5.447	-.048	-.692

* p <.05

** p <.01

Discussion

As with the results of the previous experiment examining effects of certain variables on English picture naming, Italian picture naming latencies show to have in common with English RTs the effect of one variable in particular:

the age at which a word is acquired. In addition to this, the Italian data have in common with the English findings the absence of frequency or length effects.

Another finding to emerge in Italian picture naming latencies (although not in the English findings) is the effect of name agreement. This is consistent with past findings in English by Lachman et al. (1974); Vitkovitch and Tyrrell (1995); and Snodgrass and Yuditsky (1996), where objects with more than one plausible name resulted in lengthened reaction times. As this is the first study to examine reaction times for picture naming in Italian, it is difficult to draw conclusions from past findings in languages other than English, since these are very few. However, one study by Cuetos, Ellis and Alvarez (1999) examining factors affecting picture naming in Spanish, found effects of name agreement among other variables. Closer observation of the name agreement values can explain the presence of a name agreement effect for Italian but its absence for English picture naming. For the Italian items, 36.6% had a name agreement value of 90% or less, whereas in English. only 19.9% had a name agreement of the same value, reflecting the distribution of items across the name agreement values of 65% through to 100%.

Another reason for lengthened RTs by Italian participants is that in addition to the information that an English participant must select, when an Italian participant chooses a noun for production, (s)he will need to choose the gender as well. This will influence the selection of morphophonology for both the noun and any article that precedes it. Hence, it is not the representation of gender per se that leads to Italian participants' longer RTs, but the subsequent activity appertaining to that representation.

Lastly, longer RTs by the Italian participants could have been as a result of Italian picture names being, on average, longer than the English ones (mean phoneme length = 6.16 vs. 4.36; mean syllable length = 2.83 vs. 1.61). Whilst 68.9% of Italian words were 6 letters long or more, only 42.5% of English words were of the same length. Whether this directly affected processing times could be tested further by comparing English and Italian articulation rates.

The next two experiments examine the factors affecting word naming, and allow for establishing whether the longer RTs by Italian participants persist for word reading. If Italian participants still show longer RTs in word naming, it may be assumed that they occur as a result of Italian words being longer or because Italian participants take longer to produce words than do English ones. If, instead, the longer RTs by Italian participants are limited to the picture naming task, it may be supposed that they are occurring as a result of lemma selection. The reasoning for this is because picture naming requires selection of the appropriate lemma and its corresponding lexeme (for participants in both language groups) whereas word naming is a comparatively unambiguous task which, given the regular nature of Italian, may even be performed reliably with the bypassing of semantic access.

Experiment 3

English Word Reading

Method

Participants. The participants were another group of 20 native English speakers aged between 19 and 33 (mean age = 24.2 years) from the University of York. As before, none of the participants considered themselves bilingual, and each was paid £4 or given a course credit for participating.

Materials. Experiment 1 was repeated with 20 new English native speakers. This time, though, the materials were not object pictures but their picture names in English. These were presented on an Apple Macintosh Centris computer in the centre of the screen. The words were printed in black using the font Geneva in 48pt. The variables examined this time were almost the same as the picture naming, but only those specific to word reading were included: rated familiarity, name agreement, word frequency, age of acquisition, orthographic neighbours and length.

Procedure. The equipment from the previous experiments was also used here. A fixation point of 1000 ms was presented, followed by a short delay of 50 ms and the word stimulus. Each word remained on the screen for 2000 ms with an interval of 500 ms before the next fixation dot appeared. The participants were instructed to read each object name aloud, as quickly as possible and without hesitating.

Participants familiarised themselves with the procedure by responding to the same six practice trials as in Experiments 1 and 2 (the words *sun, piano, bath, dice, whale* and *purse*). The practise items were repeated if the participant did not feel comfortable with the procedure. When (s)he was ready the experiment proper began. In all, 268 items were presented in four blocks in a fixed random order, with ten further practise items per block included. Nine words which were present as objects in Experiment 1 were omitted in this experiment, because they were object names which are ambiguous: *nail* and *bow*. As before, any hesitations or deviations from the exact target were noted and taken out before the response latencies analysed using a traditional multiple regression analysis.

Results

The mean of the participants' RTs was calculated for each word, and responses that involved the production of a word other than the one that was presented were taken out of the calculation of the means. This was the case for 11 items. Also as before, false triggerings of the voice key or voice key failures in picking up onset times on trials were also dropped from the calculation of the means, as were responses below 400 ms and above 2500 ms. This left 250 items for analysis. The mean of the naming times for these items was 527 ms (SD = 42, range 456 - 677).

Table 2.7 shows a correlation matrix showing the relationships between naming RTs for the set of 250 items and the 12 predictor variables. The variable which correlates most highly with naming latency is rated AoA (.488) followed by objective AoA (.444). Naming latency also correlates significantly, but negatively with each of the frequency measures (-.368 for Celex spoken, -441 for Celex written and -.439 for Celex combined frequency; -.402 for Kucera & Francis frequency and -.347 for rated frequency).

As with the earlier English picture naming experiment, multiple regression analyses were carried out using a combination of one of the five different frequency measures, one of the AoA measures, and this time, one of the three measures of length. The independent variable in each case was word naming latency, and the independent variables were: (a) object familiarity, (b) word frequency, (c) AoA, (d) orthographic neighbours and (e) phoneme/syllable/letter length. The results of these are shown in Table 2.8, which, as before, summarises the results of each multiple regression analysis, with each column representing the results of each analysis. For

Table 2.7

Correlation Matrix for All the Variables in Experiment 3 (n=250)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. English Word Reading RT	-	.488**	.444**	-.368**	-.441**	-.439**	-.402**	-.347**	-.329**	-.251**	-.332**	.374**	.296**	.346
2. English Rated AoA		-	.792**	-.515**	-.574**	-.575**	-.507**	-.600**	-.564**	-.386**	-.368**	.417**	.384**	.415
3. English Objective AoA			-	-.502**	-.544**	-.546**	-.448**	-.559**	-.465**	-.318**	-.299**	.256**	.257**	.275
4. Celex Spoken Frequency				-	.881**	.888**	.776**	.572**	.529**	.378**	.320**	-.356**	-.327**	-.368
5. Celex Written Frequency					-	.999**	.852**	.641**	.597**	.430**	.345**	-.431**	-.406**	-.447
6. Celex Combined Frequency						-	.854* *	.641**	.598**	.427**	.342**	-.424**	-.400**	-.441
7. Kucera & Francis Frequency							-	.554**	.481**	.481**	.373**	-.471**	-.406**	-.464
8. Rated Frequency								-	.886**	.308**	.244**	-.248**	-.269**	-.291
9. English Concept Familiarity									-	.249**	.209**	-.234**	-.278**	-.283
10. English Phonological Neigh's										-	.728**	-.600**	-.592**	-.625
11. English Orthographic Neigh's											-	-.647**	-.532**	-.567
12. English Letter Length												-	.826**	.893
13. English Syllable Length													-	.859
14. English Phoneme Length														-

* *p* <.05
** *p* <.01

English Phonological Neigh's = English Phonological Neighbours
English Orthographic Neigh's = English Orthographic Neighbours

Table 2.8

English Word Naming Summary

	English Word Naming (n=250)																													
Eng concept familiarity	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Eng Celex combined frequency	✓	✓	✓	✓	✓	✓	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Eng Celex spoken frequency	•	•	•	•	•	•	×	×	×	×	×	×	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Eng Celex written frequency	•	•	•	•	•	•	•	•	•	•	•	•	✓	✓	✓	✓	✓	✓	•	•	•	•	•	•	•	•	•	•	•	•
Eng Kucera-Francis frequency	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	✓	✓	×	✓	✓	✓	•	•	•	•	•	•
Eng rated frequency	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	×	×	×	×	×	×
Eng objective AoA	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•
Eng rated AoA	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓	•	•	•	✓	✓	✓
Eng orthographic neighbours	✓	×	×	✓	×	×	✓	×	×	✓	×	×	✓	×	×	✓	×	×	✓	×	×	✓	×	×	✓	×	✓	✓	×	×
Eng syllable length	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•
Eng phoneme length	•	×	•	•	×	•	•	✓	•	•	×	•	•	×	•	•	×	•	•	×	•	•	×	•	•	✓	•	•	×	•
Eng letter length	•	•	✓	•	•	×	•	•	✓	•	•	×	•	•	✓	•	•	×	•	•	✓	•	•	×	•	•	✓	•	•	✓

✓ = significant independent effect ($p < .05$) in simultaneous multiple regression

× = no significant independent effect in multiple regression

• = variable not entered into this analysis

example, the first column represents the analysis employing familiarity, Celex combined frequency, objective AoA, orthographic neighbours and syllable length as variables; whereas the second column represents the analysis where phoneme length was utilised in place of syllable length. The fourth column, for example, represents the results of the analysis employing rated AoA in place of objective AoA. In each analysis, the overall regression was always significant (p <.001). The best F and R^2 occurred in the analysis employing rated AoA, Celex combined frequency and letter length, with values of R^2 = .299, F= 20.90, p <.001. The details of this analysis are shown in Table 2.9. The smallest proportion of variance accounted for was .506. Strong effects were found of AoA and frequency, and orthographic neighbours and letter length also showed significant effects in some analyses.

Table 2.9.

Simultaneous Multiple Regression Analysis of Experiment 3 with Reading Latency as the Dependent Variable (using Rated AoA, Celex Combined Frequency and Letter Length)

	Regression Coefficient	*Standard Error*	*ß Coefficient*	*t*
Rated familiarity	-.170	3.024	-.004	-.056
Celex combined frequency	-12.555	5.013	-.186	-2.505**
Age of acquisition	14.873	3.591	.300	4.142**
Orthographic Neighbours	-.646	.562	-.082	-1.149
Letter length	2.539	1.617	.117	1.571

* p < .05

** p < .01

Discussion

In line with the findings from the picture naming version of this experiments, the results of the English word reading experiment indicate that the variable which exerts the strongest, most reliable and consistent effect on English reading latency is age of acquisition. Again, this is regardless of whether the objective or the rated measure is employed.

Although frequency is another variable which clearly shows an effect, its significance is dependent on which of the frequency measures is employed. This highlights the importance assigning the independent variables in experimental analyses. There was no effect of Celex spoken frequency and there was no effect of rated frequency. In this instance, the correlation matrix is a good illustration of how intercorrelated certain independent variables are, and emphasises the problem of assigning too much importance to one particular variable. Rated frequency correlates highest with concept familiarity than with any of the other frequency measures, although the ratings for these were obtained in different manners. Rated frequency measures were obtained by asking participants to rate how frequently they saw object *names*, whereas concept familiarity had been obtained by giving participants *pictures* and asking them to rate each one with regards to how often they came into contact with, or thought about the object depicted. This reflects the real life distinction between word frequency (i.e., word familiarity) and concept familiarity. Although a concept is usually accessed on presentation of an object's name, it is not the case that an object's name is accessed each time its corresponding concept is encountered. For example, streets, houses, bricks and people may be seen every day and thus their concepts accessed and they are of high familiarity, but they are not necessarily named each time they are seen.

The other independent variable shown to exert an effect on English word naming, is the measure of orthographic neighbours but this is not a consistent effect and is only present when length is measured in syllables.

Neighbourhood measurements are frequently neglected from investigations of word naming, and so the variable was used here for the purposes of exploration rather than replication. Again, it is worth looking at the correlation matrix for an explanation as to why orthographic neighbourhood effects emerge when syllable measures are used but not with phoneme or letter length. Apart from its naturally strong correlation with phonological neighbours (.728), orthographic neighbours negatively correlates highest with letter length (-.647) and phoneme length (-.567) and less strongly with syllable length (-.532). The more letters or phonemes a word contains, the fewer orthographic neighbours it will have, but syllable length does not reflect this - especially given that orthographic neighbours measures did not take into consideration neighbours of omission or addition. It should be noted here that the measure of phonological neighbours never exerted significant effects on word naming latency when the data were re-analysed employing this instead of orthographic neighbours. This is probably because phonological neighbourhood measurement is not a variable which appertains to word naming, especially given the inconsistent grapheme-to-phoneme correspondence in English. Inconsistent effects of orthographic neighbours may also be due the properties of the variable, in particular, uneven distribution. Ninety-seven items had no orthographic neighbours, 72 had between one and four neighbours, 40 had five to eight neighbours, 15 had between 9 and 12 neighbours, and 16 had between 13 and 16 neighbours. Only ten items had 17+ neighbours (the maximum number of neighbours was 24). Although the 169 items with 0-4 neighbours refelct the natural distribution in the English language as a whole, they cause the distribution to be skewed.

Consistent with past findings, and further evidence for considering the importance of *modularity* of each variable, comes from the fact that no effects were found of syllable or phoneme length, but some effects of letter length were found. Letter length emerged as significant with the objective measure of age of acquisition only, and in one analysis employing rated AoA and rated frequency. Although some of the past findings (cf. Bachoud-Lévi et al., 1998; Brown & Watson, 1987) failed to find effects of length, it must be noted that the combinations of variables employed in these past studies did not include neighbour measurements as they did here. These inconsistent effects of orthographic neighbours and letter length may be simply due to the characteristics of of the predictor variables themselves, since "..a regression solution is extremely sensitive to the combination of variables that is included in it" (Tabachnick & Fidell, 1996). The importance of an independent variable in a solution depends on the other variables in the analysis and how intercorrelated such items are. For example, the effect of letter length occurring in analyses employing objective AoA may be because letter length correlates lower with objective AoA (.257) than with rated AoA (.417), because the higher the correlation between two items, the less chance there is of either of them emerging as significant.

Experiment 4

Italian Word Reading

Method

Participants. The participants were another group of 20 native speakers of Italian aged between 20 and 31 (mean age = 26.15 years) who had just arrived at the University of York for postgraduate study. Again, none of the participants considered themselves bilingual and each was paid £4.

Materials. Experiment 2 was repeated with 20 more Italian native speakers. The materials were the Italian names for the object pictures used in

Experiment 2. These were presented on the same Apple Macintosh Centris computer, in the centre of the screen in the Geneva 48pt font in black. The variables looked at this time were the Italian versions of the following: (a) object familiarity, (b) word frequency/rated frequency, (c) AoA, (d) orthographic neighbours and (e) phoneme/syllable/letter length.

Procedure. The procedure was identical to that of Experiment 3, with a fixation point presented for 1000 ms followed by a delay of 50 ms and the word stimulus, which remained on the screen for 2000 ms. There was an interval of 500 ms before the next fixation dot appeared. The participants saw instructions in Italian, asking them to name objects as quickly as possible and without hesitating.

As with Experiment 2, seven items were excluded from analyses for having multi-word names, 4 for being borrowed words, 4 for being words depicting unfamiliar items and 4 for being homographs. Participants then familiarised themselves with the procedure by responding to the same six practice trials as in Experiments 1, 2 and 3 (the Italian words for *sun, piano, bath, dice, whale* and *purse*). If (s)he did not feel comfortable with the procedure the practice items were repeated, otherwise the experiment proper began and 270 items in blocks of four were presented in a fixed random order with ten practice items at the start of each block.

Results

Mean RTs for the responses were calculated for each word in the experiment. Five responses involving the production of a word other than the one that was presented were discounted from the calculation of the means. These occurred even more infrequently than for the English version of the same experiment - error rates were exceptionally low in Italian, possibly due to its highly regular grapheme-to-phoneme correspondence. It should also be noted here that the Italian language only contains 21 letters of the alphabet: it omits the letters *j*, *k* ,*w* , *x* and *y*. One item *piattini* [cymbals] consistently produced errors of stress misassignment. Subjects tended to allocate it a dactylic stress - as a *sdrucciola* - rather than as a penultimate syllable-stressed *piana*. False triggerings of the voice key or voice key failures in picking up onset times on trials were also omitted from the calculation of the means, as were responses below 400 ms and above 2500 ms.

Seven words which were present as objects in Experiment 2 were omitted in this experiment because they were object names consisting of more than one word in Italian - even if they have been shortened to one-word names. These were items such as: *cavalluccio marino* [seahorse], *mulino a vento* [windmill], and *ferro (da stiro)* [iron]. The "borrowed" English word names were also removed - as in Experiment 2, these were items such as *yo-yo* and *jelly*. While participants read the items, a note was made of any hesitations or deviations in reading from the exact target which were removed before the response latencies analysed using a traditional multiple regression analysis as before.

This left 245 Italian items for analysis, a considerably greater number of items than in the naming experiment given the lower error rates for reading. The mean of the reading times for these items in Italian was 583 ms (SD = 45, range = 513 - 779 ms). A correlation matrix showing the relationship between the dependent variable of Italian mean reaction time and the independent variables for these 245 Italian items used in the analysis is shown in Table 2.10.

Letter length (.438) and age of acquisition (.423) have the highest

Table 2.10

Correlation Matrix for all the Variables in Experiment 4 (Italian Word Reading, n=245)

Variable	1	2	3	4	5	6	7	8	9	10
1. Italian Word Reading RT	-	.423**	-.370**	-.271**	-.134*	-.240**	-.210**	.438**	.319**	.412**
2. Italian Rated Age of Acquisition		-	-.524**	-.567**	-.430**	-.236**	-.179*	.200**	.146*	.203**
3. Italian Written Frequency			-	.533**	.370**	.258**	.180**	-.245**	-.232**	-.254**
4. Italian Rated Frequency				-	.781**	.127*	.139*	-.009	-.043	-.044
5. Italian Concept Familiarity					-	.035	.080	-.036	.036	-.015
6. Italian Phonological Neighbours						-	.619**	-.457**	-.401**	-.467**
7. Italian Orthographic Neighbours							-	-.300**	-.264**	-.273**
8. Italian Letter Length								-	.833**	.930**
9. Italian Syllable Length									-	.871**
10. Italian Phoneme Length										-

* $p < 05$

** $p < 01$

correlation with naming time. The next variable to correlate highly with naming latency was phoneme length (.412). As would be expected, the highest correlation of all was between syllable and phoneme length (.871).

Multiple regression analyses were carried out on these remaining items, with mean naming time as the dependent variable in each analysis. For the first six analyses, only one length measure of syllable, phonemes or letters was employed, with either phonological or orthographic neighbourhood measurement. Thus, there were five independent variables, which were: (a) one of the length measures, (b) familiarity, (c) one of the frequency measures, (d) AoA, and (e) one of the neighbourhood measures.

Table 2.11 shows a summary of the results of the multiple regression analyses. As before, each column represents the results of a separate multiple regression analysis using a different combination of variables. The overall regression was significant for each analysis ($p < .001$). The best F and R^2 occurred in the analysis employing letter length, with values of $R^2 = .325$, $F = 23.004$, $p < .001$. Table 2.12 shows the results of this analysis. The smallest proportion of variance accounted for was .522, when syllable length was used. The results were very consistent from analysis to analysis, regardless of which length and which neighbourhood measure were employed. Length and AoA generally showed the most significant effects. Frequency also yielded significant effects and there were no effects of familiarity or of either of the two neighbourhood measurements.

Discussion

The results from the Italian word naming experiment are, on the whole, consistent with those from English word naming. The variable found to exert the most consistent effect in each analysis was age of acquisition. Of course, it was unfortunate that an objective measure was not available for the Italian

Table 2.11

Italian Word Naming Summary

	Italian Word Naming (n=245)					
Italian concept familiarity	×	×	×	×	×	×
Italian written frequency	✓	✓	✓	✓	✓	✓
Italian rated age of acquisition	✓	✓	✓	✓	✓	✓
Italian orthographic neighbours	×	×	×	×	×	×
Italian syllable length	✓	•	•	✓	•	•
Italian phoneme length	•	✓	•	•	✓	•
Italian letter length	•	•	✓	•	•	✓

✓ = significant independent effect ($p < .05$) in simultaneous multiple regression

× = no significant independent effect in multiple regression

• = variable not entered into this analysis

Table 2.12.

Simultaneous Multiple Regression Analysis of Experiment 4 with Reading Latency as the Dependent Variable (using Letter Length)

	Regression Coefficient	*Standard Error*	*ß Coefficient*	*t*
Rated familiarity	1.582	2.165	.044	.731
Word frequency	-11.866	5.335	-.144	-2.224*
Age of acquisition	19.806	4.465	.293	4.436**
Orthographic Neighbours	-1.018	1.592	-.036	-.639
Letter length	7.546	1.360	.333	5.769**

* $p < .05$

** $p < .01$

versions of the object names. The English rated AoA measure and the Italian rated AoA measure correlate at .72, whilst the English rated and English objective AoA measure correlate at .76; and the Italian rated and English objective measure correlate at .53. The correlation between Italian rated and English objective measure was lower because heterophonic words, and those which were 'borrowed' into the Italian language were not included in the correlation. Furthermore, this lower correlation may be as a result of cultural differences between the two groups. Nonetheless, the correlation is a positive and quite high one, and one may remain confident that the Italian rated AoA measure does provide a fair estimate of word learning age.

As with the English version of this experiment, both measures of frequency were shown to play a part in word naming latency. Stronger effects of written frequency rather than rated frequency were found, the latter of which is more appropriate to this task.

Finally, an effect of length was found when expressed as either syllables, phonemes or letters. This is consistent with many of the English word naming studies (e.g. Frederiksen & Kroll, 1973; Forster & Chambers, 1973). This is also consistent with Henderson's (1982) belief that the effect of letter and syllable word length in word naming occurs when orthographic information is translated into phonological information, whilst phoneme length affects articulatory planning. The results here are in accordance with this account, which would predict an effect of length in word naming, where translation between written word and output is necessary, but no effect in picture naming. The explanation for length effects being more uniformly present for Italian but not for English word naming may be that as with the picture naming, Italian words are not only longer than English ones, but there is a greater distribution between the lengths. For the word naming, 46% of the English words contained 6 letters or more, but 70% of Italian words were of the same length. This may also explain the absence of an effect of orthographic neighbours. As pointed out earlier, since Italian words are longer they have fewer orthographic neighbours. On average, Italian words had only 1.5 numbers of orthographic neighbours (range =0-10) whereas the English words had, on average, 3.9 orthographic neighbours (range =0-24).

As with the picture naming experiments, the Italian participants showed longer reaction times than the English participants - although this difference was smaller for word naming (583 vs. 527 ms = a difference of 56 ms, whereas for picture naming it was one of 100 ms). Again, anecdotal evidence disputes this difference being due to Italian participants being less familiar with the experimental equipment. Instead, it was supposed that the Italians were slower because of a combination of reasons, including the fact that participants were native Italians in the process of learning a second language, and also importantly, in the process of learning to *read* a second language. Although these participants were clear that the task was to be performed in Italian, it is unknown whether the learning of an irregular orthography affects reaction times in reading in a regular orthography for speakers who have only ever known how to read aloud in a shallow orthography. Once again, the difference in reaction times may also be atttributed to the fact that the Italian words were longer than the English words (see above) but further studies would be necessary to ascertain the actual effects of this. Such studies could take the form of measurement of articulation rates for the two groups of participants, or comparisons between groups of speakers of other regular (e.g. Spanish) and irregular (e.g. Hebrew) languages.

The difference between Italian and English RTs was greater for picture rather than for word naming. One reason may be that the former task would have required added cognitive activity at the lemma level for Italian participants compared to the English participants, due to the retrieval of additional lemma-level information such as grammatical gender. Retrieval of this would be necessary in a task such as picture naming, for inflection of adjectives, verbs, etc. but less necessary in word naming. Of course, for picture naming, lemma information should also be activated in monolingual English speakers, but less activity would be occurring at the lemma level compared to Italian speakers. Another explanation for there being a smaller difference for picture rather than word naming is due to the possibility of the Italian participants possessing more than one name per item because of dialects and diminutives, as compared to English participants. Whilst this would cause some interference (and competition) in a picture naming task, it would not affect word naming.

One problem with comparing English and Italian picture and word naming from these experiments is that different sets of different numbers of items are being equated. These are different subsets containing a different number or items, so the next section examines a core set of the same items across languages and tasks.

2.2. Analysis of a Common Core Set

The four separate sets of analyses from experiments 1-4 indicate interesting differences. Whilst English picture naming showed effects of AoA and marginal effects of familiarity, the variables to affect Italian picture naming were AoA and name agreement. Furthermore, although AoA, frequency and orthographic neighbours affected English word naming, the variables of AoA, frequency and length exerted effects in Italian word naming. As these were different subsets containing a different number or items, and because fair comparison requires reduction to a common set, items from the four experiments were reduced to a core set of the same 171 items.

Although on the one hand reducing the four experiments to a core set made for a fairer comparison, the outcome of doing so was that the items removed tended to be those of low familiarity, low frequency and late AoA, which resulted in sets which were not representative subsamples of the full set. For this reason, analyses of variance were computed on the by-subjects and by-items data. In the by-subjects analysis, there were two between subjects factors; one of language (*Italian* or *English*) and one of task (*pictures* or *words*).

Significant effects were found of language ($F1\ (1,3) = 16.225$, $MSE = 124188.800$ $p < .001$; $F2(1,171) = 163.52$, $MSE = 939621.44$ $p < .001$) with Italian participants taking longer to respond than the English ones (813 ms vs. 928 ms overall), and of task ($F1\ (1,3) = 460.697$, $MSE = 3526320.20$ $p < .001$; $F2\ (1,171) = 1849.04$, $MSE = 30700465$ $p < .001$) with picture naming taking longer than word naming (987 ms vs. 565 ms overall). These results were qualified by a significant interaction between language and task ($F1\ (1,3) = 5.105$, $MSE = 39072.800$ $p = .027$; $F2\ (1,170) = 90.71$, $MSE = 334245.491$ $p < .001$) as shown in Table 2.13.

Table 2.13.

Naming RTs in ms for Picture and Word Naming in English and Italian (Core Set Only)

	English	Italian	*mean*
Picture naming	928	1046	*987*
Word naming	550	579	*565*
mean	*739*	*813*	

A test of simple main effects showed a significant impact of language on task, and an impact of language on task for picture naming, but not for word reading (F1 (1,79) =1.56, MSE = 11971.60 $p = .215$).

The question remains as to why the Italian participants were slower than the English ones at picture naming. Longer reaction times for picture naming in languages other than English are not uncommon (cf. Cuetos et al., 1999, who found a global mean naming latency of 829 ms). One point made earlier was that this could be due to differences in word lengths between the two languages: Italian words are, on average, longer than English ones, and cover a wider range of lengths (this difference in distribution would also explain the emergence of a length effect in Italian but not English word naming). However, these differences would predict differences in both picture naming and word naming, but it was only apparent for picture naming. Moreover, despite these differences in length, an analysis of covariance allowing for this difference in length showed that for picture naming, the cross-linguistic difference in reaction time length did not disappear (F1 (1,170) = 53.90, MSE = 442410.27 $p < .001$).

General Discussion

To summarise, it was found that for English the variable to affect picture naming was age of acquisition, with marginal effects of rated concept familiarity. For Italian, the variable found to have strongest effects on picture naming latency was AoA (which was expressed in terms of a rated measure) and there were additional effects of name agreement. The results were fairly consistent in word naming. For the English latencies, AoA, frequency (all but the Celex spoken and rated measures), orthographic neighbours and letter length were found to exert effects. Lastly, the variables shown to affect in Italian were AoA, frequency and length. In each analysis, naming latencies were most consistently affected by the age at which the items had been acquired.

When the four experiments were reduced to a core set of common items, analyses of variance were run, and effects of language and task / format and interactions of the two were found both by-subjects and by-items. Italian reaction times were longer than English ones and picture naming latencies were longer than word naming latencies. A test of simple main effects showed that although language had a significant impact on task, task had a significant impact on language for picture naming, but not for word reading. Analyses of co-variance showed that when the differences in length (in syllables or phonemes) or in frequency across languages is accounted for, cross-linguistic differences do not disappear.

The most encouraging aspect of these four experiments is not solely in their replication of the age of acquisition effect in picture and word naming, rather, the fact that the effect occurs universally. This is the first study to examine the occurrence of the effect in Italian, and it is interesting to note that the findings are consistent with those from Spanish picture naming (Cuetos et al., 1999). In every analysis performed on the four experiments, age of acquisition emerged as the most consistent predictor, above frequency in the two word naming experiments. This is in line with previous studies of picture naming (e.g. Carroll & White, 1973; Gilhooly & Gilhooly, 1979; Morrison et al., 1992) which fail to observe an effect of word frequency on naming latency once frequency is controlled. For the picture naming experiments, familiarity (English) and name agreement (Italian) were the other variables to show effects. Again, these conform to past findings. Object familiarity was significant in some of the analyses performed by Ellis and Morrison (1998). Since it may be regarded the perceptual counterpart of word frequency (the more often object is encountered, the more easily it is identified) it is not surprising that the two variables correlate highly, and that familiarity effects only emerged for English picture naming when frequency was expressed in terms of a rated measure. Name agreement effects have also been reported in past studies (e.g. Lachman et al., 1974; Vitkovitch & Tyrrell, 1995) and their absence for English picture naming but presence for Italian picture naming may simply reflect a broader range of name agreements for the Italian objects. Of the Italian objects, 3.1% had a name agreement value of 65 - 70% (compared with 6.1% for English objects), 13.1% had a name agreement of 71 - 80% (2.8% for English objects), 19.7% had a name agreement of 81 - 90% (11% for English items) and 63.4% of Italian items had a name agreement of 91 - 100% but 80.1% of English objects had a name agreement this high. These figures reflect the Italian language containing more dialect words and diminutives than in English and so items were more likely to have a lower name agreement. Further analyses using Morrison et al.'s (1997) name agreement results for the English data still produced an absence of the effect and the same results as when the first measure was employed.

For the word naming experiments, frequency (English and Italian), orthographic neighbours (English) and length (Italian and English) were the other variables to show effects. In word reading, frequency effects found alongside AoA effects have been reported by Gerhand and Barry (1998) using written frequency measures. Morrison and Ellis (1995) contrasted the effects of frequency and AoA on word naming and found effects of AoA for sets matched on frequency but no effects of frequency for sets matched on AoA. Since the experiment here did not involve matched sets, the finding of AoA effects alongside frequency are not surprising especially given that for the English version of the study, only Celex combined, Celex written and Kucera and Francis frequency showed effects.

The finding of an effect of orthographic neighbours replicates findings by

Andrews (1989). Its effect is more likely to occur in English rather than in Italian word naming, given that Italian has a high grapheme-to-phoneme correspondence, and Italian words are longer, thus rendering it difficult for each word to have very many orthographic neighbours. Since English has a low grapheme-to-phoneme correspondence, it allows for more plausible letter clusters (e.g., *gh* may be pronounced as in *ghost*, *enough* or *through*, whereas in Italian *gh* always stands for the hardened sound as in *spaghetti*). Finally, length effects in Italian word naming reflect the larger range of lengths within the items and the fact that the Italian language is timed in terms of syllables rather than in terms of stress, as English or, for example, French are.

In order to explore the difference in reactions times between the two sets of participants, several investigations must be made. If the longer RTs arise because Italian participants take longer to process higher level, visual information, they should be slower at responding in a simple discrimination task (e.g., deciding whether a shape is a square or a triangle), whereas if the lengthened RTs are due to more time required to process semantic information, then tasks involving semantic categorisation (e.g. making the distinction between living and non-living items) should show the difference. The next two experiments address these issues.

2.3. Italian Participants and Longer Reaction Times

Two short experiments were conducted to investigate whether lengthened RTs by Italian participants arose at a high, visual level, or whether they were as a result of such participants taking longer to access semantics appertaining to given objects.

Experiment 5

Shape Discrimination

Method

Participants. There were 32 participants in all. Sixteen were native speakers of Italian who were postgraduates at the University of York and who had arrived in the UK, on average, around four months before the experiment was conducted. The mean age of these participants was 26.63 years (range = 20 - 34 years). The second group was comprised of sixteen English participants who did not consider themselves bilingual in any language. The mean age of these participants was 25.81 years (range = 20 - 34 years). Each participant was paid £2 for taking part.

Materials. The stimuli were two shapes, an 8 x 8 cm figure of a square and an 8 x 8 x 8 cm equilateral triangle. Both had been drawn using the Deskpaint program.

Procedure. Each figure was shown in black and white, in the centre of an LCIII Macintosh computer for 2000 ms. The task of the participant was to decide whether the figure in front of them was a square or a triangle as fast as possible. An asterisk fixation point was shown for 1000 ms and was offset 50 ms prior to stimulus onset, and reaction times were measured from the onset of the stimulus. There were 15 presentations of the square and 15 presentations of the triangle, and these were randomised and preceded by 20 practice trials, half consisting of presentations of the square, and half of the triangle. Half the participants pressed 'd' if the figure was a square and 'k' if the figure was a triangle. For the other half of the participants this was the other way round. The two keys were marked with a sticker with a picture of a square and a sticker with a picture of a triangle.

Results

Errors were removed from the data set. For each group of 16 participants, there were 480 responses in all (15 square and 15 triangle presentations). For the Italian group, 4 responses were taken out due to being incorrect. This translates to an error rate of .8%. A further 1.9% of responses were removed because the RT's were longer than 1000 ms. For the English group, error rates were slightly higher at a total of 11 errors (2.3%) and 1.5% of responses were removed for being over 1000 ms long. The mean reaction time for responding for the Italian group was 480 ms (range = 346 - 740 ms) and for the English group the mean RT was 447 ms (range = 308 - 700). T-tests indicated that this difference was not significant by subjects ($t1[15]=1.753$, $p=.113$) or by items ($t2[14]=2.145$, $p=.431$).

Discussion

There was no significant difference between latencies for English and Italian subjects, and also between responses for squares and triangles. The results indicate, not only that participants are more or less as efficient at discriminating between the two shapes, but that the longer reaction times for in picture naming by Italian participants cannot be due to higher level or visual effects. The next experiment will seek to find if the longer reaction times for Italian participants were due to them taking longer to process at the semantic level. If this is the case, we should see that Italian participants take longer than English ones to categorise pictures according to whether items are living or non-living.

Experiment 6

Living vs. Non-Living Categorisation

Method

Participants. The same 32 participants as in Experiment 5 took part in this experiment. Sixteen were native Italian speakers and sixteen were English speakers. Each participant was paid £2 for taking part.

Materials. The stimuli were black and white pictures from the Snodgrass and Vanderwart (1980) set. There were 40 pictures in all. Half of these were pictures depicting living items (i.e. animals) and half depicted non-living items. All pictures were matched on familiarity across sets and across languages. Each picture was presented in the centre of an LCIII Macintosh computer for 2000 ms. The pictures were presented at random and preceded by a further twenty practice items.

Procedure. The procedure was similar to that of the previous experiment but this time, the task of the participant was to decide whether the picture in front of them depicted a living or non-living item, as fast as possible. Again, there was an asterisk fixation point which was shown for 1000 ms and was offset 50 ms prior to stimulus onset. Reaction times were measured from the onset of the stimulus. Half the participants pressed 'd' if the picture depicted an animal and 'k' if the picture depicted was of a non-living item. For the other half of the participants this was the other way round. The two keys were marked with stickers with the words '*LIVING*' and '*NON-LIVING*' (or '*VIVENTE*' and '*NON-VIVENTE*' for the Italian participants) written on them respectively.

Results

Errors were removed from the set of responses. For each group of 16 participants, there were 640 responses in all (20 living and 20 non-living items). For the Italian group, 4 responses were taken out as they were incorrect. This translates to an error rate of .63% and 1.09% of responses were removed because the RTs were longer than 1000 ms. For the English group, error rates were slightly higher again at a total of 11 errors (1.7%) and 2% of responses were removed for being over 1000 ms long. There was little difference in response latencies between the two groups; the mean RT for responding for the Italian group was 564 ms (range = 312 - 936 ms) and for the English group the mean RT was 566 ms (range = 242 - 994). With regards to the living vs. non-living distinction, reaction times were the slightly slower for responses to the non-living items (581 ms) than to the living items (539 ms). This was not significant ($t2[62]=1.99$, $p=.878$).

Discussion

The aims of these experiments were twofold. Firstly, they attempted to determine whether the longer reaction times in picture naming shown by Italian participants exist at a higher level. Was it that Italian participants are slower overall than English participants on *all* tasks? Or is the difference specific to lexical tasks? After all, the Italian language has the added grammatical load of gender, leading in an increase in pre-lexical cognitive activity. When a speaker of the Italian language selects a noun, (s)he will select the appropriate definite or indefinite article and adjective inflection.

This experiment sought to investigate whether Italian participants take longer than English ones to process at the semantic level, by asking the two groups to discriminate between pictures depicting living and non-living items. Both groups of participants took slightly longer to decide that an object was non-living than that it was living. This is not surprising given that items in the "living" category were all animals but in the "non-living" category they could be anything else (although typically these items were tools and implements).

There was no difference in reaction times between the two groups. In fact, there was only a difference of 2 milliseconds between the mean reaction times. Hence, when Italian participants showed longer reaction times than English ones in picture naming, the difference was not as a result of Italian participants taking longer to process at the semantic level, and rather, to do with processing of lexical information. It is therefore probable that longer reaction times arise for two reasons overall. First, the difference may be attributed to more activity at a syntactic level (i.e., at the lemma level) associated with an increase in post-semantic, pre-lexical activity occurring as a result of the presence of grammatical gender in Italian. A second reason for lengthened reaction times in Italian may occur as a result of Italian words being longer generally.

General Discussion

One of the most important findings of these experiments is that the effects of age of acquisition were found in both picture and word naming, and in both English and Italian, which suggests that the effect is a universal one. Overall, the variables found to affect picture naming in English were age of acquisition and familiarity; whilst AoA and name agreement affected Italian picture naming. The differences arose because more Italian items had a name agreement at 90% or less than English items, reflecting the distribution of items across the name agreement values from 65% to 100%. It is also important to remember that most Italian participants would have been likely to have had more than one name for each of the items, because of dialect or diminutive names. The lack of a familiarity effect in Italian (but its presence in English) may be a result of the pictures being less familiar to the Italian participants on the whole, given that the pictures were from American and English sets.

For word naming, English naming was strongly affected by AoA and frequency with additional effects of orthographic neighbours and letter length, and Italian word naming by AoA, frequency and length. It was supposed that this difference occurred because in Italian, there was a greater distribution of items between each of the three lengths than in English. For English naming, the effects of letter length were probably due to an artefact of employing multiple regression analyses, and characteristics of letter length as a predictor variable. Significant effects of the variable only emerged in the analyses employing objective AoA, which correlated to a lower degree with letter length than rated AoA. Effects of orthographic neighbours in English only occurred when syllable length was employed in the analyses, and again, its inconsistent effects were due to orthographic neighbours having a lower correlation with syllable length than with letter or phoneme length.

As comparison across tasks and languages in this manner involved equating four subsets of different sizes, items from the experiments were reduced to a core set of the same 171 items, and analyses of variance performed. One outcome of doing this was that the items in the ANOVAS tended to be those of high familiarity and frequency, and earlier-acquired. This is because most errors were to low familiarity, low frequency and later-acquired items. Significant effects were found of language and of task by subjects and by items, with a significant interaction between the two. Italian participants showed longer RTs than English participants, and picture naming took longer than word naming. This was because there was a significant impact of language on task, and an impact of language on task for picture naming, but not for word reading.

Experiments 5 and 6 aimed to determine whether the longer reaction shown by Italian participants were due to higher level processing, or whether they were due to processing of a more semantic nature. There was no significant difference between latencies for English and Italian subjects for classifying between squares and triangles. This indicates that the longer reaction times for in picture naming by Italian participants were not due to higher level or visual effects. There was also no difference between the RTs of the two groups of participants when they were required to discriminate between pictures depicting living and non-living items. Although this latter task sought to investigate processing at a more semantic level, it may be argued that there are some visual differences between living and non-living items (pictures of living items tend to be more curved in nature but pictures of non-living items, such as tools tend to be made up of straight lines). Hence, further studies could explore this using tasks such as one where the participant is to decide whether an object is real or not, or perhaps even a semantic classification task (of the *is this item a fruit or a vegetable?* type).

The fact that there were no differences between the RTs of English and Italian participants for these two classification experiments was taken as evidence that Italian participants' longer RTs in picture naming occurred as a result of processing of lexical information rather than at a higher level of processing. Longer reaction times in Italian participants were thought to arise for a combination of reasons, including the fact that these Italians were naming pictures in a foreign country, and were early second language acquirers (further studies might examine Italian participants naming in Italy). Secondly, the difference may be as a result of increased activity at a syntactic level (i.e., at the lemma level) due to increased post-semantic, pre-lexical activity. This would have been caused by the presence of grammatical gender in Italian. Although one might argue that lemmas would also be activated in the monolingual English participants, lemma activation for this set of participants would have occurred in terms of number marking only. It could be that the combination of gender and number selection might be a contributing factor to lengthened RT's in the Italians. Lastly, a contributing factor to lengthened reaction times in Italian may have been the fact that Italian words are generally longer, and that Italian participants are more likely to speak a dialect and know diminutive names for most of the items in these studies, as compared to the English participants.

To conclude, the strength of the four naming experiments in this chapter is in their replication of effects by variables as found by past studies. These are the first studies to examine the occurrence of the effect in Italian compared to English. Another strength lies in the fact that in every analysis performed on these four experiments, age of acquisition emerged as the most consistent predictor of naming in both languages and both tasks. This suggests that the effects are universal, and not simply as a nature of the English language per se.

The findings of these experiments may be interpreted in terms of current models of lexical processing as follows. Picture naming may be thought of as involving a series of stages of processing. The first entails identifying an object, and recognising it as being familiar. This is where an effect of familiarity might have arisen. The consistent effects of age of acquisition in picture naming for both languages arose because words which are acquired earlier in life are faster to access and also faster to be produced. AoA correlates highly with frequency because the earlier an item is acquired, the more chances it will have had to have been accessed. Since these experiments show consistent effects of AoA - it is the strongest predictor of picture naming latency, we can assume it has more of a rôle to play than frequency. If one assumes lexical processing as involving two discrete and independent *lemma* and *lexeme* stages, as in Levelt's (1989) model, we can explain the longer reaction times for the Italian participants. In the *lemma* level of the model, grammatical information is encoded. This includes syntax and, for Italian speakers, a word's grammatical gender. This especially occurs in picture naming where a noun's gender would have to be retrieved in order for the correct article and adjective endings to be chosen. It is likely that Italian speakers take longer to retrieve lemma information, simply because there is more of it and it is this that contributes to lengthened reaction times. For word naming, where the word is presented in its entirety, the participant has 'clues' - from word ending - as to the gender of the noun, which is why the difference between word naming RTs for English and Italian is smaller than the difference for English and Italian picture naming.

The next chapter examines further the performance of lemma retrieval. This is somewhat difficult to carry out on English participants, given the type of information encoded at the lemma in English. However, it is possible to examine Italian participants at the stage of lemma retrieval, by way of exploring grammatical gender classification.

Chapter 3

Access to Gender Information in Italian

3.1. Grammatical Gender - A Strange Concept for English Speakers

Grammatical gender is a strange thing. *Il genere grammatico è una cosa strana.* Why is it, on the one hand, that in Italian the noun *genere* (gender) is masculine, whilst *cosa* (thing) is feminine? Grammatical gender exists in most Indo-European languages, which have two or three genders. Other languages such as Bantu have up to 20 genders (Corbett, 1991). Traditionally, it is believed that in these languages, grammatical gender "...is arbitrary. No underlying rationale can be guessed at" (Maratsos, 1979). In agreement with this was Bloomfield (1933), who noted how "...the gender categories of most Indo-European languages...do not agree with anything in the practical world...there seems to be no practical criterion by which the gender of a noun in German, French, or Latin could be determined".

One study in disagreement with the arbitrariness of gender assignment was by Zubin and Koepcke (1981), who studied 1466 monosyllabic German nouns for which gender was not determined by suffixes, and argued that there are certain rules for determining gender. They found that examination of phonetic correlations resulted in a set of 24 phonological rules which, along with morphological and semantic regularities, accounted for the gender assignment of about 90% of their set of nouns. The rules were a phonetic motivation for gender, a morphological motivation for gender and semantic determination. Amongst others, some of the rules include: if a noun ends with a consonant cluster containing a non-sibilant fricative and /t/ it tends to be feminine; a general rule that nouns with long vowels are masculine or neuter but not feminine and lastly, the finding that the more consonants a monosyllablic noun has in either initial or final position, the more likely it is to be masculine.

In Italian there are two categories of gender, with all nouns being masculine or feminine. For a handful of nouns which refer to entities with an intrinsic sex (e.g. *uomo* [man] or *donna* [woman]) the correspondence between the gender of the noun and the sex of the referent is systematic, and the gender of this type of noun could be determined by the underlying conceptual representations, or its *natural gender*. For most of the other nouns which refer to objects and abstract entities, though, gender is arbitrarily employed and referred to as *grammatical gender*. For this type of noun, gender is a strictly linguistic characteristic. For example, in Italian, the synonyms of *sasso* and *pietra* both mean 'stone' but the first is masculine and the second is feminine. Of course, gender assignment is but a single aspect of syntactic information necessary to construct phrasal structures during sentence production but it affects sentence form to a great degree. In languages with a grammatical gender system, the speaker will have to know the gender so that the noun will agree with determiners (e.g. *la tazza* [the cup, feminine] but *il bicchiere* [the glass, masculine]), some adjectives (*il pane fresco* [the fresh bread, masculine] but *la frutta fresca* [the fresh fruit, feminine]) and predicates. It is also required to ascertain co-reference between nouns and pronouns.

The function of grammatical gender in language processing has received increased attention, especially with regards to the architecture of language production and comprehension systems. According to a framework such as that of Levelt (1989) and of Levelt, Roelofs and Meyer (1999) production commences with the formulation of a pre-verbal message specifying the basic concepts that will be communicated by the speaker. This message then triggers language specific processes comprising the formulation stage, which is divided into two elements - *grammatical* and *phonological* encoding. Message elements activate lexical-semantic representations of words (*lemmas*) (Kempen & Huijbers, 1983) during grammatical encoding. These specify a word's semantic and syntactic features, and it is here that the gender of a noun is encoded. The output of this stage is then sent to the stage of phonological encoding, whereby phonological codes associated with the lemmas are recovered, and metrical and segmental codes of utterances are assigned. These are called *lexemes*. The output from this stage then serves as input to the articulatory processes where phonological plans are converted to speech. The framework has implications for languages containing grammatical gender, for in languages such as these the lemma carries gender information and thus more information than for the English language, which does not have grammatical gender.

3.2. Gender Effects in Italian

As Radeau and van Berkum (1996) and Bates, Devescovi, Hernandez and Pizzamiglio (1996) point out, there are three main techniques which have been employed in measuring gender decisions. The first is word repetition (also called 'auditory naming' or 'single-word shadowing'). Participants are simply required to repeat the second word in a series of pairs. The first word of the pair is an adjective, which serves as the grammatical context or prime, and the second word is the noun which serves as the target. This requires no metalinguistic decision and the participant does not need to attend to its gender or morphological marker. The second technique is that of gender assignment - or gender monitoring - (e.g. Deutsch & Wijnen, 1985; Bates, Devescovi, Pizzamiglio, D'Amico & Hernandez, 1995). In experiments of this nature, participants are asked to indicate the grammatical gender of a noun. Thirdly, one technique employed is that of gender verification (e.g. de Ruiter, 1992; Desrochers, Paivio & Desrochers, 1989; Desrochers & Paivio, 1990). This entails presentation of a noun with a word marking its gender, such as an article or an adjective. The role of the participant is to decide whether the two agree in gender or not. These studies typically use nouns with unambiguous gender.

Bates et al. (1996) carried out three experiments with native Italian speakers using the three aforementioned techniques of word repetition, gender monitoring and grammaticality judgement. For the first two experiments, 120 adjective-noun pairs were used, half the nouns of which were phonologically transparent (that is, masculine nouns ending with '-*o*' and feminine nouns ending with '-*a*') whilst the other half were phonologically opaque nouns (both masculine and feminine nouns ended with '-*e*'). All nouns in Italian are unambiguous for gender; so each noun is either masculine or feminine and this fixed attribute is known by native speakers. Using this class of opaque nouns allowed for an examination of the difference between overt and covert phonological cues in recognition and processing of grammatical gender. Similarly, they used 40 phonologically transparent adjectives (ending with '-*o*' and '-*a*' according to whether they modify masculine or feminine nouns) and 10 phonologically opaque adjectives ending in '-*e*'. This type of adjective is ambiguous; that is, the adjective does not change its ending according to whether it modifies a masculine or a feminine noun, it simply keeps its '-*e*' ending all the time (for singular nouns). Since these adjectives do not change their endings with noun gender, they offer no information about the subsequent noun so they can serve as a neutral baseline against which facilitatory or inhibitory effects of phonologically transparent gender can be assessed. This has firm ecological validity given that such combinations are common in Italian.

For the word repetition task, participants were required to repeat the second word of each pair as fast as possible. There was a random assignment of noun targets to adjective prime, which permitted a comparison of facilitation (the reaction times for concordant adjective-noun pairs compared to the neutral condition) and inhibition (the reaction times for discordant adjective-noun pairs compared to the neutral condition). Significant main effects for adjective-noun concordance and for noun gender were found. That is, nouns in discordant pairs were named slower than those in the neutral condition and nouns in concordant pairs were named fastest. This suggests effects of inhibition and facilitation respectively. Bates et al. argue that the fact that gender priming occurs within such a short time window indicates that gender processing occurs very early on in word recognition. The main effect of noun gender was reflected in faster RTs on feminine than on masculine nouns (938 ms vs. 972 ms), which is the opposite of what we might expect, given that more masculine than feminine nouns exist in the Italian language. However, performance may have been affected by correlations between gender and phonological transparency in Italian.

In the gender monitoring task, Bates et al. asked participants to rate the gender of a target noun by pressing one button for masculine and another one for feminine nouns. Once more, reaction times were calculated according to concordant and discordant pairs compared to the neutral baseline. Three significant main effects were found for concordance (concordant noun RTs < neutral noun RTs < discordant noun RTs), gender (feminine word RTs were faster than those for masculine words) and phonological transparency (RTs for phonological transparent words were faster than those for phonologically opaque words). In contrast to the last experiment, gender monitoring provided evidence for significant inhibition but the facilitation effect was not reliable. A difference also occurred for phonological transparency, in that words ending with the opaque '-*e*' yielded longer reaction times in this task.

Finally, in the grammaticality judgement experiment, procedures were similar to the gender monitoring task, but participants judged whether each adjective-noun pair was grammatical or ungrammatical. Here, only 80 adjective-noun pairs were used, 40 concordant and 40 discordant. The neutral baseline of '-*e*' ending adjectives could not be employed here, since the phonologically opaque adjectives always have '-*e*' endings regardless of whether they modify masculine or feminine nouns, which would have made it impossible to employ a discordant condition. Two main effects were observed, the first was that of concordance (faster RTs for concordant, "grammatical" items than for discordant, "ungrammatical" items) and secondly , for phonological transparency (faster grammaticality judgements for transparent '-*a* / -*o*' endings than for opaque '-*e*' endings). There was also a significant interaction between gender and ending. Overall, the fastest RTs were for feminine nouns with phonologically transparent ('-*a*') endings whilst the slowest RTs were found for feminine nouns with phonologically opaque ('-*e*') endings.

The findings therefore show consistent priming effects when target words are preceded by gender marked adjectives. Gender priming also involves an inhibitory component (response times to incongruent nouns were longer than to neutral controls). In establishing the nature and locus of gender priming, Bates et al. have concluded that part of the variance in gender priming is contributed by automatic processes occurring prior to word recognition. This is supported by the fact that in all three tasks, there was a difference between congruent and incongruent conditions, despite there being a predictive validity of 50% for the prime, which suggests that native speakers of Italian have rapid and automatic responses to gender information which is difficult for them to suppress.

The fact that phonologically transparent nouns were processed quicker than those with opaque endings in gender monitoring and grammaticality judgement implies that Italian speakers find it easier to make explicit gender decisions when the end of a word contains a transparent phonological cue. This effect was interpreted as occurring post lexically and reflecting a "checking" process especially when participants were asked to make an explicit decision about gender identity and gender agreement, and the absence of transparency effects for word repetition supports this. The finding that participants responded faster to feminine nouns on word repetition and gender monitoring could not be explained by word frequency or length, as these were counterbalanced over genders, but Bates et al. propose that it may be due to differences in total word duration.

3.3. Gender Effects in Other Languages

Studies examining the effect of grammatical gender on language have also been carried out in other languages, employing the lexical decision paradigm in both the visual and auditory stimulus modalities. Gurjanov, Lukatela, Lukatela, Savic and Turvey (1985) carried out lexical decision tasks in the visual domain and found both facilitation and inhibition for lexical decisions for masculine and feminine nouns in Serbo-Croatian. In their experiments, targets were preceded by congruent or incongruent adjectives which had been inflected by gender, compared to a baseline condition using pseudo adjectives, constructed by employing orthographically legal letter strings. Carello, Lukatela and Turvey (1988) conducted a similar experiment but with certain differences. Instead of using pseudo adjectives as a prime they used "xxx" and a semantic condition was also included. They employed the same set of stimuli in lexical decision and naming tasks and included pseudo words in the naming task. An effect of gender congruency of 4 milliseconds was found in the lexical decision task but not for naming. This could be attributed to the inclusion of pseudo words, which may have encouraged sublexical reading.

In a study employing Dutch participants, Jescheniak and Levelt (1994) required native speakers of Dutch either to name pictured objects or to categorise objects according to the gender of their names. Dutch has three genders, masculine, feminine and neuter; for masculine and feminine nouns the singular and definite article (equivalent to *the* in English) is *de*, while for neuter words it is *het*. Gender categorisation was turned into a binary task by asking participants to press one button for *de* words (masculine or feminine) and another button for *het* words (neuter). In Experiments 1 (naming) and 3 (gender categorisation) sets of objects with high or low frequency names were presented three times. For naming there was a substantial frequency effect on all three repetitions, but for gender categorisation an effect of frequency in the first presentation of the sets disappeared by the third presentation. Jescheniak and Levelt (1994) argued that participants may have accessed spoken-word forms (lexemes) in the early stages of the gender categorisation task, but that with practise they were able to base their response solely on lemma activation. Hence, Jescheniak and Levelt took the view that word frequency affects access to lexemes but not lemmas.

3.4. Grammatical Gender and Two-Stage Models of Word Production

Proposals regarding representation of grammatical information have been made with respect to serial-processing models (Roelofs, 1992; Bock & Levelt, 1994; Jescheniak & Levelt, 1994), which assume that grammatical information is represented independently of semantic and phonological information. The assumption that lexical retrieval consists of the two main stages of lemma and lexeme recovery has been demonstrated in many studies, including evidence from those investigating slips of the tongue (Garrett, 1976; Fay & Cutler, 1977; Dell, 1986), tip-of-the-tongue states (Vigliocco, Antonini & Garrett, 1997; Miozzo & Caramazza, 1997) and in neuropsychological case studies (Henaff Gonon, Bruckert & Michel, 1989; Badecker, Miozzo & Zanuttini, 1995; Miozzo & Caramazza, 1997). For example, Garrett (1976) showed the existence of errors where one word is substituted by another in spontaneous speech, and it was evident that there is a relationship between the target and obtruding word in such errors. Some types are substitutions where the two words have similar meanings, whereas others are where the two words are phonologically similar. Although this does not prove the existence of an abstract lexical representation which is separate from a conceptual one, the tip-of-the-tongue studies do provide evidence for a failure in retrieving full phonological word forms after successful access to the correct abstract representation.

According to two stage models of lexical access certain predictions can be made, including that speakers should be able to report syntactic features for words which they cannot name, and even in the absence of any phonological information. The next experiment examines whether longer reaction times by Italian participants in Experiments 2 and 4 were due to longer time spent processing at a post-semantic but pre-lexical level. According to two stage models of lexical retrieval such as the WEAVER++ (Levelt, Roelofs & Meyer,1999), word form encoding consists of three strata of nodes and after the conceptual stratum is one containing lemma nodes followed by a word-form stratum. By asking participants to classify pictures according to whether they depict objects with masculine or feminine names (without actually retrieving the name itself) it should be possible to see evidence of lemma retrieval in the absence of retrieval of the word form (or lexeme). Hence, the next experiment also allows for address of the issue of gender retrieval whilst employing a different approach in comparison to past studies.

This chapter commences with a simple gender classification experiment. In Experiment 7 participants were required classify a large set of black and white pictures according to whether their names depicted a noun that was masculine or feminine. Some of the pictures were of pictures with regular-ending nouns, whilst others were of pictures which had ambiguous '-*e*' endings and others were of nouns with irregular endings - that is, of feminine nouns ending with '-*o*' and masculine nouns ending with '-*a*'. These last two types of noun endings were of particular importance, for if gender retrieval occurs at the lemma participants should be able to retrieve the correct gender for them, even though they are not required to name each picture. Age of acquisition was entered into a simultaneous multiple regression analysis along with gender transparency, word frequency, length and other factors to see which factors made independent contributions to predicting the speed of responding in the two tasks. Experiment 8 employed another set of participants who categorised and named sets of pictures with early or late acquired, masculine or feminine names that were matched on the other factors.

Experiment 7

Gender Categorisation

Method

Participants. Eighteen native speakers of Italian who were postgraduates at the University of York and aged between 19 and 31 years (mean age = 26 years) participated in the experiment. None of the participants considered themselves bilingual, and each was paid £4 for taking part.

Materials. The experimental items selected for the present study were a subset of 157 black and white pictures of the 270 items from the original analyses of the Italian naming data from Experiment 3. Of these, 137 were taken from Snodgrass and Vanderwart (1980) and 16 from Morrison, Chappell and Ellis (1997). The remaining 4 had been drawn by Morrison et al. in a style similar to that of Snodgrass and Vanderwart (1980). In order to include as many pictures as possible from the naming experiment, the name agreement criterion was lowered to 70%. That is, at least 14 out of 20 participants had previously given each item in the stimuli its correct name in the picture naming experiment. but only five items had a name agreement of 70% and the majority had name agreements between 90% and 100%).

For presentation to participants the 157 experimental items were mixed with practise and filler items which included additional objects with masculine and feminine names ending in -e, but lower name agreements; also some objects with masculine names ending in consonants and some with plural names ending in -i, the aim being to discourage as far as possible a strategy of categorising the gender of an object's name by naming that item subvocally and making a judgement based on the phonology of the name.

It was attempted to incorporate a variety of noun endings among the stimuli. However, ensuring equal numbers of each ending type as well as an equal split between masculine and feminine items was an extremely difficult operation, in part exacerbated by the fact that there is not a 50:50 split between masculine and feminine nouns in the language.[1] The items of particular interest were the phonologically opaque ones - that is, the '-*e*' ending nouns - since there are both masculine and feminine nouns with this ending. However, most '-*e*' ending feminine nouns in Italian tend to refer to abstract entities (for example *la porzione* [the portion] *la competizione* [the competition]) and are thus not pictureable.

Also of interest were the pictures with names with irregular endings - those which are masculine but end in -*a*, and feminine but end in -*o* because if participants retrieve gender from their phonological strings, these should be misassigned. There are only a handful of these in the Italian language, so only a few were included. Items with intrinsic or *natural* gender were omitted as they have obvious gender, as were items with two names and with one name of each gender. For example, the word *barrel* has a picture in the set, but it has two names: *il barile* which is masculine in gender and *la botte* which is feminine.

In total, 78 of the objects had masculine names, of which 48 had the regular -o ending (e.g., *braccio* [arm]) and 30 the opaque -e ending (e.g., *pane* [bread]). The remaining 79 items had feminine names, with 75 having the

[1]A random count of one page per letter of the Italian alphabet from '*Il Nuovo Zingarelli Minore: Vocabolario della Lingua Italiana*' (N. Zingarelli, 1997) found that there were 597 masculine and 325 feminine words. Of these, 73 words were '-*e*' ending and masculine and 65 were '-*e*' ending and feminine. However, it is important to note that although this type of count may give a rough indication of masculine-feminine ratio in the language as a whole, it does not tell us of the ratio for concrete nouns, such as those contained within the Snodgrass and Vanderwart picture set.

regular -a ending (e.g., *farfalla* [butterfly]) and 4 the opaque -e ending (e.g., *volpe* [fox]). The remaining 113 pictures that occurred as fillers included 6 whose names have masculine consonant endings (e.g., *thermos* [flask]), two with masculine -i endings (e.g., *sci* [ski]), one with a feminine -i ending (*forbici* [scissors]), four with masculine plural -i endings (e.g., *capelli* [hair]), one with the exceptional masculine -a (*gorilla* [gorilla]), one with the exceptional feminine -o (*mano* [hand]) and 18 with the opaque -e ending. Altogether there were 141 masculine and 129 feminine items.

Gender categorisation reaction times were measured and entered into a multiple regression analysis. The variables included in the analysis were: gender (masculine or feminine), gender transparency (how predictable the gender of each noun was from its phonology), gender agreement (this was the proportion of participants who attributed one or the other gender to each item), visual complexity, rated familiarity, age of acquisition, word frequency, length (in phonemes or syllables) and name agreement. This variable of name agreement is the number of alternative plausible responses assigned to an item. These responses may be correct but, as they fail to match the target name, they are treated as errors. In the case of gender agreement, the variable reflects simple accuracy of classification, because for each item there exists a definite and correct response (i.e. 'masculine' or 'feminine'). Miscategorisation of gender of and item could occur for a number of reasons, including because of categorisation by semantic connotation, being under time pressure, or simply not knowing the gender of the item in question. The Italian ratings employed in the previous analyses for picture naming were used.

Procedure. The procedure was similar to the one for the Italian picture naming experiment (Experiment 2). The stimuli were presented in the centre of a computer screen using the PsyScope experiment generator package on an Apple Macintosh Power Mac computer. A central fixation point was shown for 1000 ms followed, after a brief interstimulus interval of 50 ms by a picture which was displayed for 2500 ms. There was an initial trial block of 10 practise items, after which the stimuli were presented in four blocks of items, each of which began with at least 5 filler items. Within each block the pictures were presented in a pre-set, semi-random order, with not more than four masculine or feminine items in succession. Half the participants pressed 'd' if the picture of the object had a masculine name and 'k' if the object had a feminine name. For the other half of the subjects this was the other way round. The keys were marked with a sticker labelled 'F' for 'femminile' (*feminine*) and 'M' for 'maschile' (*masculine*). The participant's reaction time to the picture was recorded to the nearest millisecond. After the picture's presentation, there was then an interval of 500 ms before the next fixation dot appeared, which was followed 1000 ms later by the next item. The items were presented in a fixed random order, to ensure that there were not more than four items of any one gender presented simultaneously. The instructions were as follows:

Fra qualche minuto vedrai una serie di disegni di oggetti. Devi decidere se ogni disegno dipinge un oggetto col nome maschile o femminile. Senza dire il nome. Se il disegno dipinge un oggetto col nome femminile, premi la 'd'. Se ha il nome maschile, premi la 'k'. Provi di non esitare. Le tue risposte saranno registrate, allora provi di rispondere il più veloce possibile. Premi il mouse per continuare.

(In a few minutes you will see a series of pictures of objects. You must decide if each picture depicts an object with a masculine or feminine name. Do not name the object. If the picture depicts an object with a feminine name, press '*d*. If it has a masculine name, press '*k*'. Try not to hesitate. Your responses will be recorded, so try to respond as quickly as possible. Press the mouse to continue).

Participants were tested individually in sessions lasting around 20 minutes. They used the initial practise phase to familiarise themselves with the procedure. If the participant felt (s)he understood the procedure and was ready to begin the experiment proper, the 157 test trials began. These were arranged in four blocks of around 45 items with a further 5 practise items at the start of each block, and whose reaction times were omitted in the analyses. The presentation of blocks were counterbalanced. If the participant did not feel comfortable with the task, the practise sessions were repeated, and short breaks were given in between each block.

Results

Any incorrect responses were removed from the analyses. The definition of an incorrect response included assigning an item the wrong gender (i.e. saying that an item was masculine when it was feminine and vice versa), incorrect key press (pressing a key other than '*k*' or '*d*') and no responses. Responses shorter than 400 ms or longer than 1500 ms were also removed.

Four participants' responses were removed from the experiment. Participant 11's responses were discarded because 94 (53.1%) of them had to be taken out; participant 18 had her responses removed due to 58 responses (32.8%) having to be taken out; participant 19 had 52 (29.4%) responses to be removed and so was taken out, and finally, participant 22 was taken out for having had 66 (33.9%) responses removed. This left 18 participants' responses.

At this stage there were 2826 responses in all (18 participants x 172 responses). A total of 427 responses (15.1%) were removed from the analysis. These comprised of 27 misclassification errors, 5 trials in which no key was pressed, and 148 trials in which the participant took longer than 1500 ms to respond. This had been as chosen as the criterion as it was reasoned that if participants took longer than this they might be naming the picture. Although the criterion of 400 ms was adopted to remove the shorter responses, none of the responses were taken out for this reason.

This left a total of 2,399 correct responses for analysis. The mean gender categorisation latency for the 157 experimental objects was 910 ms (range 687 to 897 ms). Table 3.1 shows the correlations between the different predictor variables and their correlation with gender categorisation speed.

Gender categorisation RT showed its highest correlation with gender agreement: that is, items which attracted more misclassification errors also tended to have slower mean RTs for correct responses. There were also significant raw correlations with grammatical gender, name agreement and gender transparency. The correlations of gender categorisation RT with visual complexity, age of acquisition, word frequency (written or rated) and word length (syllables or phonemes) were all low and not significant.

Also apparent from the correlation matrix, is the fact that although picture naming RT from Chapter 2 correlates with visual complexity, familiarity, age of acquisition, frequency, name agreement, phonological neighbours and length, gender classification RT only correlates with gender type, gender agreement, name agreement and gender transparency.[2] This confirms the specificity of each task, and confirms the involvement of higher level (visual and semantic) processes in naming but not in gender retrieval. Since variables such as AoA and frequency are lexical variables, their high

[2] When picture naming reaction times to the same items (from Chapter 2) are entered in a correlation matrix along with gender naming RT, picture naming RT correlates with gender classification RT, gender agreement, visual complexity, AoA, frequency and name agreement.

Table 3.1.

Correlations Between Gender Categorisation RT and the 10 Predictor Variables in Experiment 7 (n = 157).

	1	2	3	4	5	6	7	8	9	10	11
1. Gender categorisation RT	1.00	.053	-.307**	.225**	-.642**	-.279**	.134	-.053	-.152	.103	.092
2. Visual complexity		1.00	-.031	-.036	-.105	.053	.269**	-.114	-.214**	.182*	.234**
3. Grammatical gender			1.00	-.383**	.060	-.076	-.024	-.138	.023	-.065	-.004
4. Gender transparency				1.00	-.071	-.045	.172*	-.008	-.102	.129	.076
5. Gender agreement					1.00	.214**	-.057	.082	.179*	-.062	-.023
6. Name agreement						1.00	-.296**	.180*	.019	-.066	-.091
7. Age of acquisition							1.00	-.412**	-.333**	.269**	.299**
8. Written word frequency								1.00	.284**	-.249**	-.234**
9. Rated word frequency									1.00	-.076	.017
10. Number of syllables										1.00	.879**
11. Number of phonemes											1.00

* $p < .05$ ** $p < .01$

correlations with picture naming but no correlation with gender classification reaction time is also evidence that for the latter task, participants were not naming objects first and then deducing the name.

A simultaneous multiple regression analysis was carried out with gender categorisation speed as the dependent variable and visual complexity, grammatical gender, gender transparency, gender agreement, name agreement, age of acquisition, written word frequency and syllable length as factors. Word frequency was subjected to a log (1+*x*) transform to reduce skew. A second analysis involved the same factors but with phoneme length rather than syllable length. Two more analyses used rated rather than written word frequency. In each analysis, the overall regression was always significant (p <.001).

In these multiple regressions, some variables are binary (namely, grammatical gender and gender transparency) whilst the others are continuous. However, as the dependent variable was reaction time, multiple rather than logistic regression analyses were carried out. In their analyses of gender accuracy, gender monitoring and word repetition RTs, Bates et al. (1995) include a number of dichotomous variables such as grammatical gender, semantic gender, humanness, abstractness and presence/absence of a fricative or affricate in the initial consonant, and they employed stepwise regression as a tool for analysis. Masculine and feminine responses were not analysed separately, because there were only 79 masculine and 78 feminine responses overall, and this would have resulted in analyses employing only four independent variables.

The analysis giving the best F and R^2 was the one employing rated frequency and phoneme length ($R^2 = .524$, $F = 20.342$, $p < .001$). The smallest proportion of variance accounted for was .521. The results of the four analyses are shown in Table 3.2. The results were essentially the same in each case: grammatical gender made a significant independent contribution to predicting gender categorisation RT, reflecting the fact that categorisation RTs were faster to objects with feminine names than to objects with masculine names. There were also significant independent contributions of gender agreement and name agreement, with faster RTs being associated with high levels of agreement in both cases. Effects of visual complexity, gender transparency, age of acquisition, word frequency and word length did not approach significance in any analysis.

For gender categorisation, the effect of gender simply reflects the fact that feminine objects were classified faster than masculine ones overall (877 ms vs. 944 ms). This was consistent with Bates et al. (1995) who found that feminine nouns were responded to faster than masculine nouns in the tasks of gender priming and gender monitoring. The other significant predictors of gender categorisation RT were gender agreement and name agreement.

There are several reasons to suppose that participants were not naming the items before categorising them (not even sub-vocally). Firstly, it was emphasised in the instructions that participants should *never* name the item presented, and participants had ample opportunity to practise classifying whilst not naming. Secondly, had the participants named the pictures first and *then* categorised them, there would have also been effects of the other variable to affect Italian picture naming - age of acquisition. There were no AoA effects; despite there being strong effects of the variable in Italian picture naming. Also, if participants *had* been naming these items that they were required to classify for gender, the average reaction times would have been longer than those for picture naming. The average reaction time for all

Table 3.2.

Results of Four Simultaneous Multiple Regression Analyses of Gender Categorisation RTs using Either Written or Subjective Word Frequency and Either Number of Syllables or Number of Phonemes for Experiment 7

	Analysis 1			Analysis 2			Analysis 3			Analysis 4		
	ß coefficient	Standard error	*t* value	ß coefficient	Standard error	*t* value	ß coefficient	Standard error	*t* value	ß coefficient	Standard error	*t* value
Visual complexity	-2.64	8.07	-0.33	-3.55	8.11	-0.44	-3.02	8.11	-0.37	-4.15	8.18	-0.51
Grammatical gender	-55.97	13.83	-4.05**	-56.29	13.78	-4.09**	-56.39	13.66	-4.13**	-56.87	13.63	-4.17**
Gender transparency	18.60	17.27	1.08	18.42	17.19	1.07	18.24	17.29	1.06	17.87	17.21	1.04
Gender agreement	-24.54	2.47	-9.93**	-24.62	2.46	-9.99**	-24.33	2.50	-9.71**	-24.34	2.50	-9.75**
Name agreement	-200.31	79.42	-2.52*	-198.23	79.25	-2.50*	-203.69	79.81	-2.55*	-202.55	79.59	-2.55*
Age of acquisition	7.53	13.87	0.54	6.22	13.89	0.45	5.21	13.65	0.38	2.90	13.79	0.21
Written frequency	0.07	0.58	0.12	0.98	0.57	0.17	-	-	-	-	-	-
Rated frequency	-	-	-	-	-	-	-3.38	7.96	-0.42	-4.50	8.03	-0.56
Number of syllables	3.33	7.67	0.43	-	-	-	3.31	7.56	0.44	-	-	-
Number of phonemes	-	-	-	3.49	3.70	0.94	-	-	-	3.73	3.71	1.01

* p <.05 **p <.01

items for gender classification was 910 ms, but the average reaction time for picture naming for the same items was 1025 ms. Furthermore, action had been taken to ensure that participants had not named the items by removing any response over 1500 ms from the analyses.

It was supposed that the effect of name agreement originated in the fact that in some instances - such as with the items with lower name agreement - participants had simply accessed the wrong lemma. This idea is also consistent with the notion that participants may have received interference from a competing lemma. Vitkovitch and Tyrrell (1995) analysed the sources of differences in name agreement and argued that they may have two origins. The first lies in object recognition and semantics and reflects the fact that some objects are easier to recognise from line drawings than others. Some drawings may be ambigious as regards the particular object being depicted causing some participants to misidentify the object and hence name it incorrectly (e.g., responding vase [*vaso*] to a picture meant to be of a jug [*brocca*]) as occurred in the Italian picture naming experiment in Chapter 2. In this example, *vaso* is masculine while *brocca* is feminine, the perceptual error would be reflected in a gender miscategorisation, contributing to low gender agreement for that item. In a naming task the perceptual error would result in a misnaming, contributing to low name agreement. The effects of gender and name agreement probably reflect this source of error rather than Vitkovitch and Tyrrell's (1995) second source, which is where alternative correct names exist for the same object, so that a picture of a settee could also be called a *sofa* or *couch* in English, while a picture of a submarine could be called *somergibile* or *sottomarino* in Italian.

Discussion

The main point to emphasise about this gender categorisation experiment is that it was conducted for the purposes of exploration rather than replication. Thus, there were many points to note. Firstly, the main problem lay in the fact that participants were asked to classify the pictures as to whether the object depicted was one of a feminine or a masculine grammatical gender. It was not known whether participants were actually naming the items first and then categorising them. There are a number of reasons to suppose that participants were not naming the items first. Firstly, mean reaction times for gender classification were shorter than those for picture naming. Secondly, in the multiple regression analyses, there were no effects of (a) lexical variables such as AoA, which did show effects in picture naming of the same items and (b) gender transparency, which we would expect if participants were accessing names first (i.e., phonologically transparent items would be easier to classify than phonologically opaque ones). Had participants named the items and *then* classified them, these two points would have been apparent. In fact, the average reaction time to phonologically transparent items was longer than to phonologically opaque ones.

Although there was an effect of name agreement, this was supposed to have occurred as a result of participants accessing the wrong lemma - or rather, the right lemma but for the wrong item, or from interference from a competing lemma. This explanation is supported by the fact that when items with a name agreement lower than 90% were removed, the effects of name agreement were lost.

One weakness of this experiment was that it did not control for superordinate or semantic gender categorisation. In the selection of items for this experiment, items with intrinsic sex and with obvious correspondence between grammatical gender and referent sex were avoided (e.g. *giudice* [judge] is a masculine word - for either a male or female judge - but the picture in the Snodgrass & Vanderwart set depicts a male judge). For some items, however, certain semantic rules could be applied most of the time, and classification of these items could have occurred through the application of these rules. For example, in Italian, most fruits are feminine (e.g. *ciliegia* [cherry], *uva* [grapes], *arancia* [orange] and *fragola* [strawberry]) whilst most parts of the body are masculine (e.g. *braccio* [arm], *orecchio* [ear], *naso* [nose] and *piede* [foot]). Although exceptions do exist, a few participants reported using this as a strategy for classifying some of the items. As well as the application of these generalisations, analysis of the gender agreement values showed that many subjects were allocating each item its associative gender. The items *vestito* [dress] and *ago* [needle] for example, are both masculine in grammatical gender, but are items which are more often than not associated with feminine entities. And although the items *motocicletta* [motorbike] and *vite* [screw] possess typically masculine attributes, they are feminine in grammatical gender.

Whilst this rule appears to be true for the latter semantic category, it is possible to examine whether this strategy had been employed by most participants can be tested, as exceptions to these rules exist. Items such as *la mano* (hand) was a body part of a feminine gender (albeit an exceptional one) but was still categorised correctly by 16 out of 18 participants. Similarly, *la pecora* (sheep), *la rana* (frog) and *la giraffa* (giraffe) are all animals which are grammatically feminine in gender and had a gender agreement of 17, 16 and 16 respectively. Furthermore, when multiple regression analyses were run with items of a more obvious semantic category taken out, results were highly consistent.

Although a written version of the same experiment adopting the word names would have prevented the use of these strategies, participants would be more likely to use the *'a' ending = feminine, 'o' ending = masculine* phonological rule, thus allowing for effects of transparency and regularisation. Instead, gender categorisation and picture naming latencies to the same objects were examined using a semi factorial design half of feminine and half of masculine items with AoA manipulated orthogonally and with the variables of gender agreement and name agreement, visual complexity, word frequency and length held constant. This design was utilised to explore further the lack of effects of lexical variables in gender categorisation but their exertion in picture naming. In the first past of Experiment 8 participants classified the set of pictures by gender and in the second part the participants named the same set.

Experiment 8

Gender Classification & Naming of a Matched Picture Set

Method

Participants. Twenty native speakers of Italian who were either postgraduates at the University of York or their visiting friends, and who were aged between 19 and 31 years (mean age = 26 years) participated in the experiment. Each participant was paid £4 for taking part. Five of the participants had been in the UK for a day or two, having just arrived as tourists. The ones who were living in the UK had been doing so for an average of 6.4 months.

Materials. Sixty-four pictures taken from the Snodgrass and Vanderwart set, with sixteen each in the following conditions: (i) masculine, early-acquired (e.g. *ombrello* [umbrella], *coltello* [knife]), (ii) feminine, early-acquired (e.g. *bicicletta* [bicycle], *forchetta* [fork]), (iii) masculine, late-acquired (e.g. *arco* [bow - as in the weapon], *pozzo* [well]) and feminine, late-acquired (e.g. *sega* [saw], *conchiglia* [shell]). The starting point for selecting items were the 157 items from the previous gender classification experiment, minus items with a gender agreement less than 14 out of 20 participants

(70%) and those with name agreement less than 90%. This left 125 items. The median was taken, and early acquired pictures had a range of at between 1.71 and 2.44 whilst late acquired pictures had a range of between 2.57 and 3.81. These values were taken from the ratings which had been administered to 22 native Italian speakers for Experiment 2. The scale for this ran from 1 to 7, where 1 = *acquired at 0-2 years*, 4 = *acquired at 7-8 years* and 7 = *acquired at 13+years*. As well as being matched on gender agreement and name agreement, the words in each category were also matched on the factors of visual complexity (as taken from Morrison, Chappell & Ellis, 1997), word frequency (as taken from Bortolini, Tagliavini & Zampolli, 1971 and the rated measure from Chapter 2) and syllable length.

Both sets had AoA manipulated orthogonally and the variables of gender and name agreement, visual complexity, word frequency and length were held constant. This design was utilised to explore further the lack of effects of lexical variables in gender categorisation, but their exertion in picture naming.

Procedure. This experiment replicated the previous gender classification and picture naming tasks, the only difference being in the items which formed part of matched sets. The experiment was programmed using the Superlab package (Cedrus Corporation, 1988). The pictures appeared in random order for 2500 ms each, in the centre of an Apple Macintosh Power Mac computer with a fixation dot shown for 1000 ms and offset 50 ms prior to stimulus onset. Reaction times were measured from the onset of the stimulus to the nearest millisecond. The first part of the experiment involved the participants categorising the pictures by their gender. That is, half the participants pressed 'd' if the picture of the object had a masculine name and 'k' if the object had a feminine name. For the other half of the subjects this was the other way round. The keys were marked with a sticker labelled 'F' for 'femminile' (*feminine*) and 'M' for 'maschile' (*masculine*). The instructions were exactly the same as before.

For the second part of the experiment, participants were presented with exactly the same pictures (including the same filler items) to name as fast as possible, without hesitating. The instructions were exactly the same as for Experiment 2 (Chapter 2), with vocal response reaction times measured in milliseconds using a high sensitivity microphone which had been set separately for each participant's vocal volume. Participants were tested individually in sessions lasting around 20 minutes. and used the initial practise phase to familiarise themselves with the procedure. When (s)he understood the procedure, the experiment proper began. If the participant did not feel comfortable with the task the practise sessions were repeated.

The two parts of the experiment were counterbalanced across participants. That is, half the participants were required to categorise the objects by gender and then to name them, whilst the other half were required to name the objects first and then to categorise them. Within the two sets of participants, for gender categorisation, half were required to press the 'd' if the picture of the object had a masculine name and 'k' if the object had a feminine name and half were instructed the other way round.

Results

Gender categorisation and naming involve very different types of response. For gender categorisation the response is manual with just two alternatives whereas for naming the response is vocal and the alternatives are, arguably, all the object names in the speaker's vocabulary. For this reason, data from the two tasks were analysed separately.

Gender Classification

Any incorrect responses were removed from the analyses. For gender categorisation, 209 incorrect responses (13.6%) were removed, comprising 173 categorisation errors (pressing the wrong key) and 36 no responses. Harmonic means of correct RTs were used for calculating both the by-subjects and the by-item means. The harmonic mean is a measure of central tendency that involves a reciprocal transformation of the data which has the effect of reducing skew caused by slower responses and which therefore does not require elimination of long RTs. It is recommended by Ratcliff (1993) as suitable for use with analysis of variance.

The results are shown in Table 3.3. By-subjects (F1) and by-items (F2) analyses of variance (ANOVAs) were carried out on the gender categorisation RTs with task order, grammatical gender and age of acquisition as factors. The effect of task order was significant by items (F2 1,60) = 61.37, MSE = 313,929, $p < .001$) reflecting a tendency for categorisation responses to be faster when gender categorisation was done first (overall mean = 842 ms) than when done after naming (overall mean = 909 ms). This effect was not, however, significant by subjects ($F1(1,22) = 1.42$, MSE = 108,676, $p = .246$). The effect of grammatical gender was significant in both analyses ($F1(1,22) = 15.70$, MSE = 103,359, $p < .001$; $F2(1,60) = 14.57$, MSE = 119,744, $p < .001$) with overall RTs being faster to feminine items (overall mean = 842 ms) than to masculine items (overall mean = 908 ms). The effect of age of acquisition did not approach significance in either analysis and none of the interactions was significant.

By-subjects and by-items analyses of variance were carried out on the gender categorisation error rates with task order, grammatical gender and age of acquisition as factors. The effect of grammatical gender was significant in the by-subjects analysis ($F1(1,22) = 6.14$, $MSE = 115.04$, $p < .05$) but this effect was not significant in the by-items analysis. The main effects of task order and age of acquisition were not significant in either analysis, and none of the interactions was significant.

Picture Naming

In all, seventy (4.56%) incorrect responses were removed from the analyses. These were 46 incorrect names, including visual and semantic errors (e.g. *giacca* [jacket] for *gilé* [waistcoat], *sedia* [chair] for *sgabello* [stool]) and diminutive errors (e.g. *campanella* [little bell] for *campana* [bell]), 19 no responses and 4 voice key failures.

Table 3.3.

Mean Gender Categorisation and Naming RTs (and Standard Deviations) and Percent Errors to Early and Late Acquired Items of Masculine or Feminine Gender for Experiment 8

Task	Task order		Early AoA		Late AoA	
			Masc.	Fem.	Masc.	Fem.
Gender categorisation	1st	Mean RT	864	811	882	809
		SD	196	175	192	150
		% error	14.6	10.9	16.2	14.1
	2nd	Mean RT	943	863	943	885
		SD	130	87	113	77
		% error	13.0	10.9	20.3	8.9
Naming	1st	Mean RT	838	799	870	840
		SD	81	89	91	126
		% error	3.1	2.1	5.2	4.2
	2nd	Mean RT	829	794	887	877
		SD	131	91	108	125
		% error	4.7	3.1	10.4	3.7

By-subjects (F1) and by-items (F2) analyses of variance were carried out on the naming RTs with task order, grammatical gender and age of acquisition as factors. Grammatical gender was significant by subjects ($F1(1,22) = 9.27$, $MSE = 19{,}013$, $p < .01$) reflecting a tendency for naming responses to be faster to feminine items (overall mean = 838 ms) than to masculine items (overall mean = 856 ms). This effect was not, however, significant by-items ($F2(1,22) = 1.55$, $MSE = 29{,}343$, $p = .219$). The effect of age of acquisition was highly significant by-subjects ($F1(1,22) = 24.16$, $MSE = 68{,}213$, $p < .001$) and close to significance by items ($F2(1,60) = 3.68$, $MSE = 69{,}751$, $p = .060$) .Overall naming were faster to early acquired (overall mean = 815 ms) than to late acquired items (overall mean = 869 ms). The effect of task order was not significant in either analysis and none of the interactions were significant.

The small number of naming errors precluded an analysis using ANOVA. Nonparametric Wilcoxon tests showed significantly more errors to masculine than feminine items ($Z = 2.50$, $p < .05$) and to late than early acquired items ($Z = 1.99$, $p < .05$). Error rates did not differ significantly according to whether the naming task took place before or after the gender categorisation task.

In terms of age of acquisition, the reaction time data support the findings of Experiment 2 (Chapter 2) in that age of acquisition affects the speed of object naming but not the speed with which objects can be categorised according to the gender of their name. This was confirmed in a combined analysis of RTs for gender categorisation and naming with task, task order, gender and age of acquisition as factors. The overall effect of age of acquisition was significant by-subjects ($F1(1,22) = 19.84$, $MSE = 47{,}344$, $p < .001$) though not by items ($F2(1,60)$ $p = 2.35$). Importantly, age of acquisition showed an interaction with task that was significant in both analyses ($F1(1,22) = 10.63$, $MSE = 23{,}034$, $p < .001$; $F2(1,60) = 3.82$, $MSE = 22{,}256$, $p = .05$) and which reflects the demonstration in the separate analyses of each task that age of acquisition affected naming but not gender categorisation speed.[3]

In Experiment 7, gender categorisation was faster to objects with feminine names than to objects with masculine names. The effect of gender on categorisation RT was found in Experiment 8 which also found a tendency for naming responses to be faster to feminine than masculine items that was significant by-subjects but not by-items. It has already been noted that there are more masculine than feminine nouns in Italian: if categorisation speed were based upon the frequency with which masculine and feminine 'nodes' are activated, then it might be expected that masculine items would be categorised faster than feminine items, but the opposite is true. If feminine lemmas were accessed faster than masculine lemmas, the Levelt model would predict that naming RTs should also be faster to feminine than masculine items (because access to phonological word-forms (lexemes) occurs via the lemmas, so a variable affecting lemma access would also affect naming). Bates et al. (1996) also found faster responses to feminine words in gender monitoring and word repetition tasks. They make little of this result, supposing it to be due to hidden correlations in length and phonological transparency, or to measurable differences in total word duration as a function of gender and transparency. These reasons are unlikely, given that participants were not naming the items gender categorisation, also given that items were controlled for length, and given that there were no effects of gender transparency in analyses of the data from gender classification multiple regressions. Instead, feminine nouns are categorised faster than masculine nouns because they are somewhat less complicated in terms of singluar/plural declensions. There are more masculine forms than there are

[3] The results were consistent when the data were analysed with the removal of any outliers greater than 2.5 and 3 standard deviations from the mean.

feminine forms in Italian, which makes feminine nouns more distinct than masculine ones. Evidence to support this notion comes from the fact that in Experiment 7, not only were mean RTs to transparent feminine -a ending nouns faster than those to transparent masculine -o ending nouns (874 vs. 932 ms), but mean RTs to feminine -e ending nouns were also faster to those for masculine -e ending nouns (910 vs. 950 ms).

Finally, the absence of any repetition priming between the two tasks is noted. Naming RTs were as fast when naming was carried out first (overall mean = 837 ms) as when naming followed categorisation of the same pictures for gender (overall mean = 847 ms). Gender categorisation actually showed a trend towards being *slower* when categorisation followed naming (overall mean = 909 ms) than when participants carried out the categorisation task first (overall mean = 842 ms). This was significant in the by-items analysis though not in the by-subjects analysis.

Discussion

Experiment 7 showed no effect of lexical variables or of gender transparency on gender agreement, which suggested that participants were not naming items that they had been asked to classify. The fact that these lexical variables - especially age of acquisition (as found in Experiment 2, Italian picture naming, in the previous chapter) - do show effects in picture naming suggests that the two processes of gender classification and picture naming were, indeed, different and distinct. In Experiment 7 there had been an effect of name agreement on gender classification, which arose from participants accessing the wrong lemma or from competing lemmas, so for Experiment 8, name agreement was controlled with it ranging from 78% to 100%.

For this experiment, a factorial design consisting of one half feminine and one half masculine pictures of items was employed, with AoA manipulated orthogonally and with the variables of gender agreement, name agreement, visual complexity, word frequency and length held constant. Participants either named and then categorised by gender or first categorised by gender and then named the set. This allowed for exploration of the exertion of AoA effects in picture naming but not in gender classification, and also for direct comparison between the two tasks.

For gender classification, significant effects of gender were found, with participants responding faster to feminine than to masculine items. The finding is in the opposite direction from what might be predicted given that there are more masculine than feminine word types in the language as a whole. This replicates the findings of Bates et al. (1996) who also found that participants responded faster to feminine words in gender monitoring and word repetition tasks. According to Bates et al., faster RTs to feminine nouns occur because of hidden correlations in length and phonological transparency, or as a result of differences in total word duration. However, length was held constant in the factorial experiment, and there were no effects of transparency in the regression experiment. One other reason, instead, may be because feminine nouns more distinct than masculine ones, and less complicated on the whole, given that there are more masculine than feminine forms overall in Italian. Further support for this comes from mean RTs to the different categories of item: not only were participants faster at responding to transparent feminine than transparent masculine nouns, but average RTs to feminine -e ending nouns were faster than those to masculine -e ending nouns in Experiment 7.

There were no effects of age of acquisition, even though the Italian picture naming experiment in the previous chapter found it to be the strongest predictor of picture naming. Given that in order to retrieve a picture name, a speaker has to retrieve its appropriate semantic and grammatical properties, this suggests that the effects of AoA are not arising at the level of grammatical encoding, rather, *after* it. Lastly, effects of order occurred in the by-items analysis only, with gender reaction times being slower for the items when they had been named as pictures first. The results were consistent when outliers of two and a half standard deviations from each mean response were removed, which is not surprising as very few responses were removed for being outliers (23 by-subjects and 24 by-items).

For picture naming, the strongest effects were exerted by AoA in a by-subjects analysis of variance, and there were strong effects of gender, but no effect of order, which is consistent with the proposal that AoA exerts its effects post-lemma. The fact that AoA exerted strongest effects is consistent with the previous picture naming experiment (Chapter 2, Experiment 2) where AoA was found to be the strongest predictor of naming latency in Italian. Mean reaction times for that experiment were longer at 1046 milliseconds - the mean reaction time for picture naming here was 888 milliseconds - which reflects the fact that here, the items were all of a high name agreement.

General Discussion

This chapter set out to provide an exploratory investigation into to retrieval of grammatical gender in Italian native speakers. Instead of employing the techniques of word repetition, gender monitoring and grammaticality judgement to examine gender decisions, or of reporting measures of TOT or single case studies, this chapter examined which factors *affect* gender classification latencies and at which stage in object name retrieval it occurs.

According to the results of Experiment 5 in the previous chapter, whereby English and Italian native speakers discriminated between triangles and squares, the difference in reaction times did not occur at a higher or visual level. There was no significant difference between English and Italian participants' reaction times. This led to the question of whether the lengthened reaction times were due to Italian participants taking longer to process at the semantic level. Experiment 6 had required the two groups of participants to make a semantic decision by dichotomising between pictures depicting living and non-living items. A difference of only 2 milliseconds between the English and Italian mean reaction times revealed that Italian participants' longer reaction times for picture naming were not as a result of Italian participants taking longer to process at the semantic level.

According to two stage models of lexical retrieval, such as Levelt, Roelofs and Meyer's (1999) WEAVER++, there are three strata of nodes and after the conceptual stratum is one containing lemma nodes. Since at this stage, we had ascertained that the difference in English and Italian RTs was not due to visual or semantic differences in processing, the difference had to be due to extended time spent at the lemma or lexeme level by Italian participants.

Experiment 7 using gender categorisation was conducted for the purposes of exploration rather than replication. Participants were simply asked to classify the pictures as to whether the object depicted was one of a feminine or a masculine grammatical gender. The mean reaction times were shorter than those for picture naming to the same items which suggested that in order to make a correct classification of an object's grammatical gender, retrieval of the name is not necessary (hence reports such as that of

Badecker et al. 1995, of patients who can retrieve grammatical in the absence of phonological information). Multiple regression analyses found no effects of lexical variables such as AoA, which *did* show effects in picture naming of the same items or of gender transparency. This would have been expected if participants were accessing names first and making gender decisions afterwards. Consistent with Italian picture naming, an effect of name agreement occurred. This was either as a result of participants accessing the wrong lemma (or instead, the correct lemma but for the wrong item) or from interference from a competing lemma, supported by the effects of name agreement being lost when items with a name agreement lower than 90% were removed.

Since there were no effects of lexical variables (such as AoA) or of transparency and as reaction times were shorter, on average, than naming reaction times to the same items, Experiment 8 kept this method but used a factorial design. A set of half feminine and half masculine items was created with AoA manipulated orthogonally and with the variables of gender agreement and name agreement, visual complexity, word frequency and length held constant. To explore further the lack of effects of lexical variables in gender categorisation but their previous exertion in picture naming, participants in this experiment either named and then classified by gender the set of pictures or classified and then named the set.

The effects of age of acquisition *only* occurred for the picture naming task, where it exerted the strongest effects (consistent with the previous Italian picture naming experiment). Apart from providing evidence for the independence of gender retrieval and name retrieval as tasks , and evidence of the involvement of two stages in lexical retrieval, these results provide further answers. According to Barry, Morrison and Ellis (1997), theoretical explanations of the AoA effect must now ascertain *where* the locus of the effect is - that is, at which processing stage is it localised. They conclude that AoA effects are likely to be at the level of the lexeme. These results are in accordance with this view. Morrison et al. (1992) found that AoA did not affect categorisation of object pictures by 'natural' or 'man-made, which rules out AoA being a variable influencing recognition or comprehension of pictures. Furthermore, as AoA showed an effect in the production of an object name (where the speaker must retrieve its appropriate grammatical *and* phonological properties) but not in gender classification (where the speaker must simply access the grammatical properties), its effects at the lemma level may also be ruled out. As effects of AoA only arose for picture naming and not for gender classification, its influence must arise *after* lemma selection.

To conclude, age of acquisition affects access to phonological word-forms (lexemes) but not word-specific syntactic information (lemmas). This could be because lemmas precede lexemes in a serial stage order or because access to the two sets of representations occurs separately and in parallel.

With regards to how it is that early acquired phonological representations are easier to access than later acquired ones, certain theoretical accounts of vocabulary acquisition in childhood propose that the phonological representations of early words are relatively unstructured and unsegmented (Ferguson, 1986; Jusczyk, 1986; 1993). The steady growth of vocabulary, possibly coupled with the acquisition of literacy (Goswami & Bryant, 1990; Snowling & Hulme, 1994) causes phonological representations to become increasingly segmentalised and structured into separate syllables and phonemes (Fowler, 1991; Metsala & Walley, 1998; Walley, 1993). This would be very much in accordance with Brown and Watson's (1987) phonological completeness hypothesis of age of acquisition effects, in which early learned words remain somewhat wholistic in their structure well into adulthood. Early learned words have more unified phonological representations than later acquired words. This leads to early-acquired words requiring less assembly prior to pronunciation, and thus being produced faster than later-acquired words in object naming. For gender categorisation judgements, such phonological assembly process is not required, as such judgements do not involve covert naming, hence resulting in an absence of an effect of age of acquisition.

Chapter 4

Exploration of the Bilingual Lexicon: A Review of the Literature

4.1. What is bilingualism and why should it be explored as a separate topic?

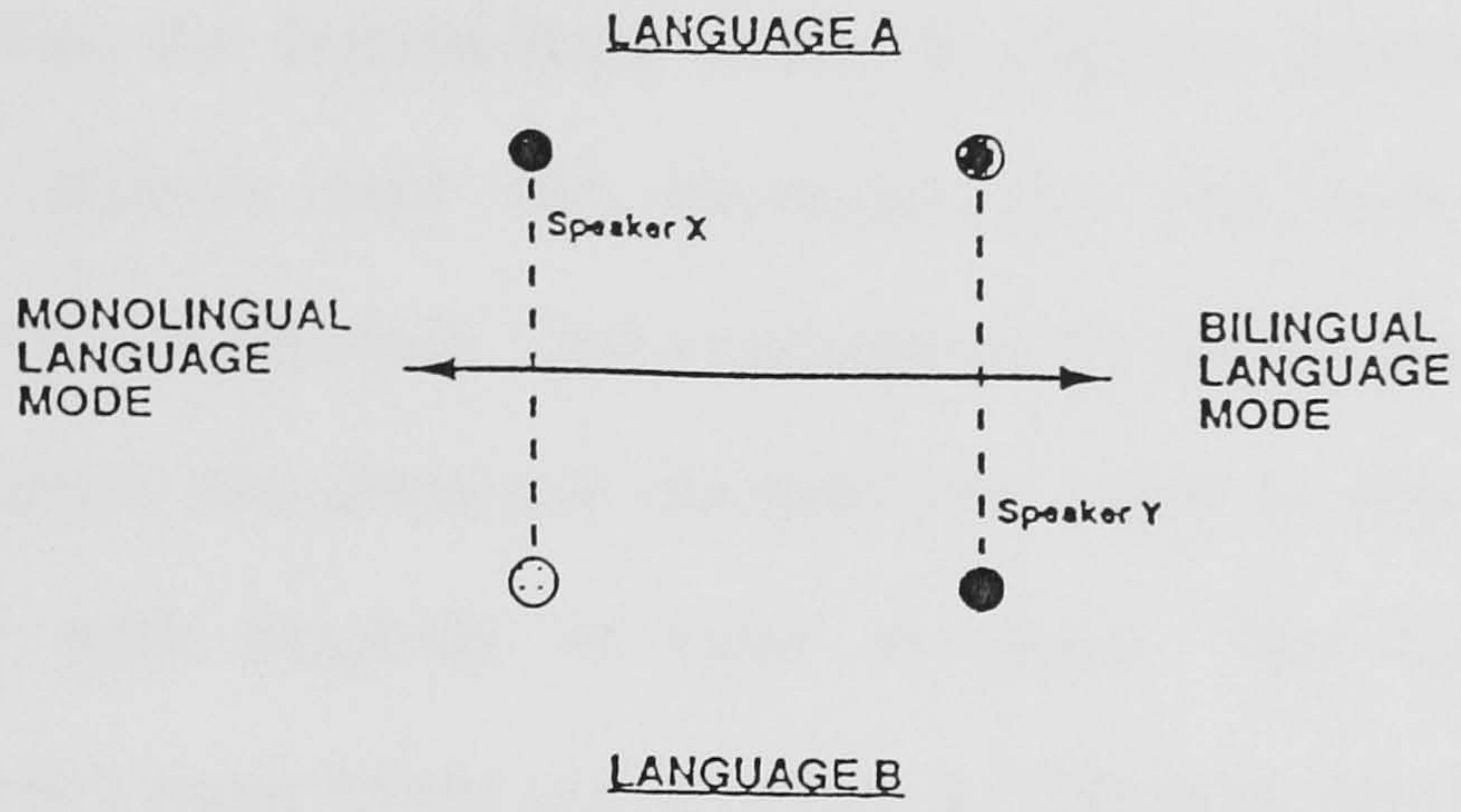
As various authors have indicated (Harris & Nelson 1992; Paradis 1985; Hamers & Blanc 1989), attempting a definition of bilingualism is not as easy as one might assume. Even defining a native speaker of English has provided problems (Palij & Aaronson, 1992) as native English speakers do not form a homogenous group, and neither do bilinguals (Paradis 1985). Since language use incorporates the four modalities of reading, writing, speaking and listening, and a person's skill in these four modalities may vary vastly, the situation becomes more complicated when one is considering a person's skill in each modality for two languages.

Opinions vary on the degree of capacity required in each modality of each language in order to define a person as a bilingual. Authors such as Bloomfield (1935) define bilingualism as simply a "native-like control of two languages" (an opinion shared by Thiery, 1978) whereas others such as Macnamara (1967) view a bilingual as requiring to possess only minimal proficiency in one of the four modalities. Between these two extreme opinions lie the viewpoints of the bilingual being someone able to speak and follow concepts and structures in a second language rather than just paraphrasing the first (Titone, 1972). Grosjean (1998) identifies a number of methodological and conceptual issues that arise in the studying of bilinguals, including the fact that there are problems in defining the characteristics of the bilingual individual in terms of language history, proficiency and use, etc. Citing Caramazza and Brones' frequently reported (1980) study dealing with Spanish-English bilinguals, he explains how the only information given about these speakers is that they were native speakers of Spanish ranging in their self-ratings of fluency from good to excellent, with a mean rating of 5.5 out of 7 on a rated scale. The problem of insufficient information is especially present in the patient studies (e.g. Perecman, 1984), with too few details given about the patient prior to and after the onset of the pathology.

Whilst it is not the concern of this thesis to review these definitions they raise important issues and actually refer to *level of proficiency* - merely a single dimension of bilinguality. More realistically, Grosjean (1985) sees the bilingual as a competent speaker-hearer who operates at various points along a continuum with total monolingual speech in either language situated at one end and bilingual speech with other bilingual speakers situated at the other. This end incorporates 'mixed' language production, i.e. code-switches and borrowings (Figure 4.1). Bilinguals vary in the extent at which they travel along this continuum; some may rarely find themselves at one end of it. Bilinguals also vary in terms of which speech mode they will normally operate in. In some tight-knit immigrant communities, for example, the norm may be mixed language. Grosjean (1998) points out that it is important to know where bilinguals are positioned on the language mode continuum. Treffers-Daller (1997) found that when a Turkish-German bilingual was placed in three different positions of the continuum by changing context and interlocutors, different patterns of code-switching were found. The participant used fewer code-switches when speaking to another bilingual he did not know well than when speaking to a very close bilingual friend.

Figure 4.1. Grosjean's Language Mode Continuum (Grosjean, 1997).

The speaker's position is represented by the broken vertical lines and level of language activation by the shade of the circles (black = *active*, grey = *partly active*, white = *inactive*).



Bilingualism is common world-wide, not only in immigrant communities, but in the smaller, relatively monolingual countries which are surrounded or bordered by other countries where a different language is spoken. This has resulted in bilingualism being the norm rather than the exception (Harris & Nelson, 1992; Cook, 1997) with 50% of the world's population speaking two or more languages (Crystal 1987; Grosjean 1992).

Internal strifes or economic problems of some countries have sent massive emigration groups outwards. Large scale emigration in the 1950s from Africa, the Caribbean, South Asia, the Baltic States and Southern Italy have rendered Great Britain a multi-cultural nation. Although these speakers started as second language acquirers, now that thirty or so years have passed and proficiency has increased they may be considered bilingual and their offspring as compound bilinguals, where both the mother tongue and second language have been used to similar degrees. The languages spoken in these immigrant populations are of a crystallised form and, having evolved outside of their natural environments, have not developed in the same manner as their original counterparts. Tosi (1984) identifies the Italian spoken by emigrants in England as being loaded with English borrowings, interference and transfers. In analysing linguistic behaviour of Italians in Bedford, Tosi suggests that the borrowings occur to replace items with different names in different dialects and this demonstrates the insufficiency of the Italian immigrant's vocabulary for expression in different surroundings. The more removed from the domestic domain the topic is, the more borrowings exist - especially with regards to local services. The borrowings also represent habits which have been acquired in a different environment, as even a mere "cup of tea" (*una cappati*) is often offered in English. According Faerch and Kasper (1983) and Poulisse (1990) code-switching occurs as a compensatory strategy. If a bilingual has an incomplete Language 2 but a complete Language 1 system the latter may be accessed where there is no availability of a word in the former. Grosjean (1982) agrees that code-switching initially occurs through the lack of a particular word in one of the languages or by the greater availability in the other language.

In Grosjean's (1985) opinion it is important not to regard the bilingual as being the sum of two whole monolinguals, as the 'monolingual' (fractional) view dictates. This view postulates that the bilingual has two independent, separable language abilities similar to those of corresponding monolinguals and has resulted in various outcomes - mainly that bilinguals have been described in terms of fluency and proficiency for both languages and that their skills in each language are assessed by monolingual standards, or that their state of bilingualism is considered accidental. This leads to bilinguals viewing their own language capabilities as inadequate or incomplete. It is largely due to this fractional view that much of the research has been conducted in terms of a bilingual's individual and separate languages. Instead, Grosjean prefers the 'bilingual' (wholistic) view which posits the bilingual to be an integrated whole and not decomposed into two separate parts, as (s)he is equipped with a unique and specific linguistic configuration. Being a fully competent speaker-hearer, the bilingual has developed his/her abilities in each language to the standard required by his/her environment and has the ability to use both languages together or separately depending on the purpose. Levels of proficiency in each language will depend on how much the bilingual needs to use that language and will be domain specific.

It is important for one to distinguish between bilinguals and second language learners as the two populations have particular characteristics. Although a general opinion in the literature suggests that the difference between the two is clear cut, they merely operate along different points of the continuum. In second language learners, acquisition of the second language is incomplete whereas in bilinguals the separate language stores are thought of as more or less 'complete' - of course, it cannot be assumed that the two stores are symmetrical as bilinguals rarely possess two symmetrical languages stores (Grosjean 1989). Second language learners possess a smaller vocabulary and this may hinder expression of their intended message which in turn, leads to them utilising compensatory strategies and finding alternative manners of expression (Poulisse 1990; Faerch & Kasper, 1983). They also have under-developed grammatical knowledge and so may avoid certain structures in their second language (Schachter, 1974) or produce ungrammatical sentences (Van Els, Bongaerts, Extra, Van Os & Janssen-Van Dieten, 1984). Wiese (1982, 1984, cited in Poulisse,

1997) reported more hesitation phenomena (repetitions, corrections and filled pauses) and longer pauses but shorter runs of speech in second language learners - results also reported by Möhle (1984). Lennon (1990) found a relationship between temporal variables and proficiency, reporting that as speech rate and length of run increased with proficiency, number of repetitions and pauses decreased. This is somewhat different to bilinguals, who are able to use their first and second languages interchangeably and are also able to keep the two apart (Poulisse, 1997).

Monolingual models do not account for these subtleties in bilingual speakers or in second language learners. It is hardly surprising that object recognition and word production models have concentrated on monolingual speech: the process is complicated enough in one language. However, given that bilingualism is now recognised as being widespread, a model is required to explain the processes in bilingual word production. De Bot (1992) identifies that "many aspects of speaking are the same for monolingual and bilingual speakers...a single model to describe both types of speaker is to be preferred over two separate models". He argues that a monolingual model could be taken and its validity tested by applying it to bilingual speakers since the monolingual speaker has the capacity to become bilingual - and perhaps vice versa, given that some bilingual aphasics sometimes show complete loss in one language but not in the other (Winterling, 1978; Paradis, 1983; 1987); and the knowledge of a second language may decline with age (as shown in Weltens' 1989 work on the attrition of French as a foreign language). Even if an adequate model is not produced instantaneously, at least assumptions on bilinguals' language storage and organisation are being made explicit in the process (Meara, 1989).

4.2. Models of Bilingual Word Recognition and Production

A model of bilingualism may be constructed by adapting existing monolingual models to incorporate bilingual speech by looking at neuropsychological evidence from brain-damaged bilinguals and by examining cognitive experimental results. A final model should have the capacity to explain results from each of these areas.

De Bot (1992) identifies several requirements which a bilingual version of Levelt's (1989; 1999) model would need to meet to account for both balanced and non-balanced bilinguals' speech. These include: separate and mixed use of the two language systems - as demonstrated by the aforementioned literature on code-switching occurring at various levels (Giesbers 1989); cross-linguistic influences (Odlin, 1989); possible differences between monolinguals and bilinguals in speed of production (Mägiste 1986); first and second language proficiency and the asymmetry that may exist in both language systems either as a result of incomplete acquisition or loss of skill (Weltens, 1989; de Bot & Clyne, 1989), and number of languages. As this thesis is concerned with *bi*lingualism, little will be mentioned about *multi*lingualism, but a model which assumes each monolingual has the capacity to become bilingual should also account for a bilingual's capacity to become multilingual, and "...must be able to represent interactions between these different languages" taking typological differences into account (de Bot, 1992).

In his attempts to convert Levelt's model to account for bilingualism, de Bot aims to keep the original model as intact as possible. His assumption that the conceptualizer is not language specific, so a single system will suffice for knowledge of the different conventions required by each language spoken, is consistent with Paradis' (1987) view that there is no difference in registers used by a monolingual or a bilingual, and with most recent models (such as that of de Groot, 1992) which propose the existence of a common set of amodal, language-independent, conceptual representations. De Bot assumes that register, along with choice of language, is in the preverbal message and that language selection occurs in the macroplanning whilst language-specific encoding occurs in microplanning.

In terms of storage and retrieval for each language, de Bot believes the two most important factors are linguistic distance between the two languages and level of proficiency in either. Linguistic distance is a problematic factor (Hinskens, 1988) and is important because it has implications for numbers of cognates and shared syntax rules. For example, the difference between Italian and Spanish is smaller than that between English and Korean. The speaker of two closely related languages will use similar procedural and lexical knowledge than the speaker of two lesser-related languages.

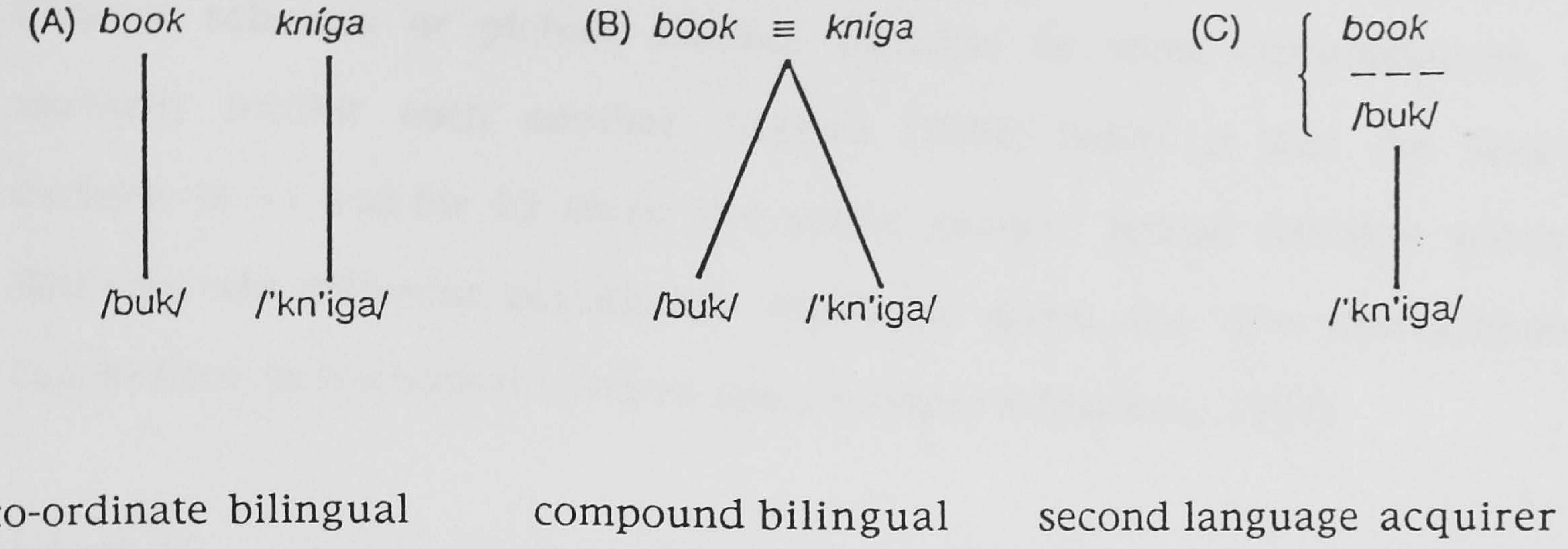
Level of proficiency is important because it has implications for storage and bilingualism is different to second language acquisition where only a few words may be known and do not require a separate system. Kerkman's (1984) findings that non-balanced bilinguals stored their two languages separately to a greater extent than balanced bilinguals support this view. In his study manipulating cognateness and levels of proficiency, different results were obtained for intermediate and near-native bilinguals - there were no cross-language repetition effects for the group of near-native bilinguals which lead him to conclude that this group perform almost completely language-specific processing. There are, however, problems with this view which stem mainly from the fact that there has been little research manipulating proficiency. Also, the term "stored separately" may have several interpretations. It may refer to complete separation between the two languages, or to partial separation where elements from one language are stored completely separately and may be wholly activated when that language is chosen for production. An example of the latter is Paradis' subset hypothesis (1987, 1997) which assumes varying degrees of activation for each language depending on which is being used (Faerch & Kasper, 1986) and that linguistic behaviour is sensitive to cues in the environment (Bates & MacWhinney, 1989). Given that the whole language process is too complex to be treated as a whole and needs to be broken down into more specific areas, "stored separately" may also refer to the distinction between syntax and lexical processes with syntax in a separate store for each language but lexical processes overlapping or vice versa.

4.2.1. Weinreich's (1953) Early Studies on Bilingualism

Much of the earlier work in bilingualism centred around the question of one storage or two separate storages. Weinreich's very early work (1953) did not consider proficiency but did offer different types of bilingual lexical organisations (Figure 4.2) and much of the more recent research is based on these ideas.

Weinreich (1953) argued that co-ordinate bilinguals have one 'signified' for every 'signifier', so each word in a bilingual's first language and its translation in the second language have separate conceptual forms - one for the word in each language. Compound bilinguals have one set of 'signifieds' with two 'signfiers' - so here, separate lexical items are represented by one conceptual form. The subordinative configuration represents the second language acquirer - here, the word to be learnt is linked to its translation equivalent rather than to its conceptual form.

Figure 4.2. Three Organisations of Word Knowledge in Bilinguals (Weinreich, 1953)

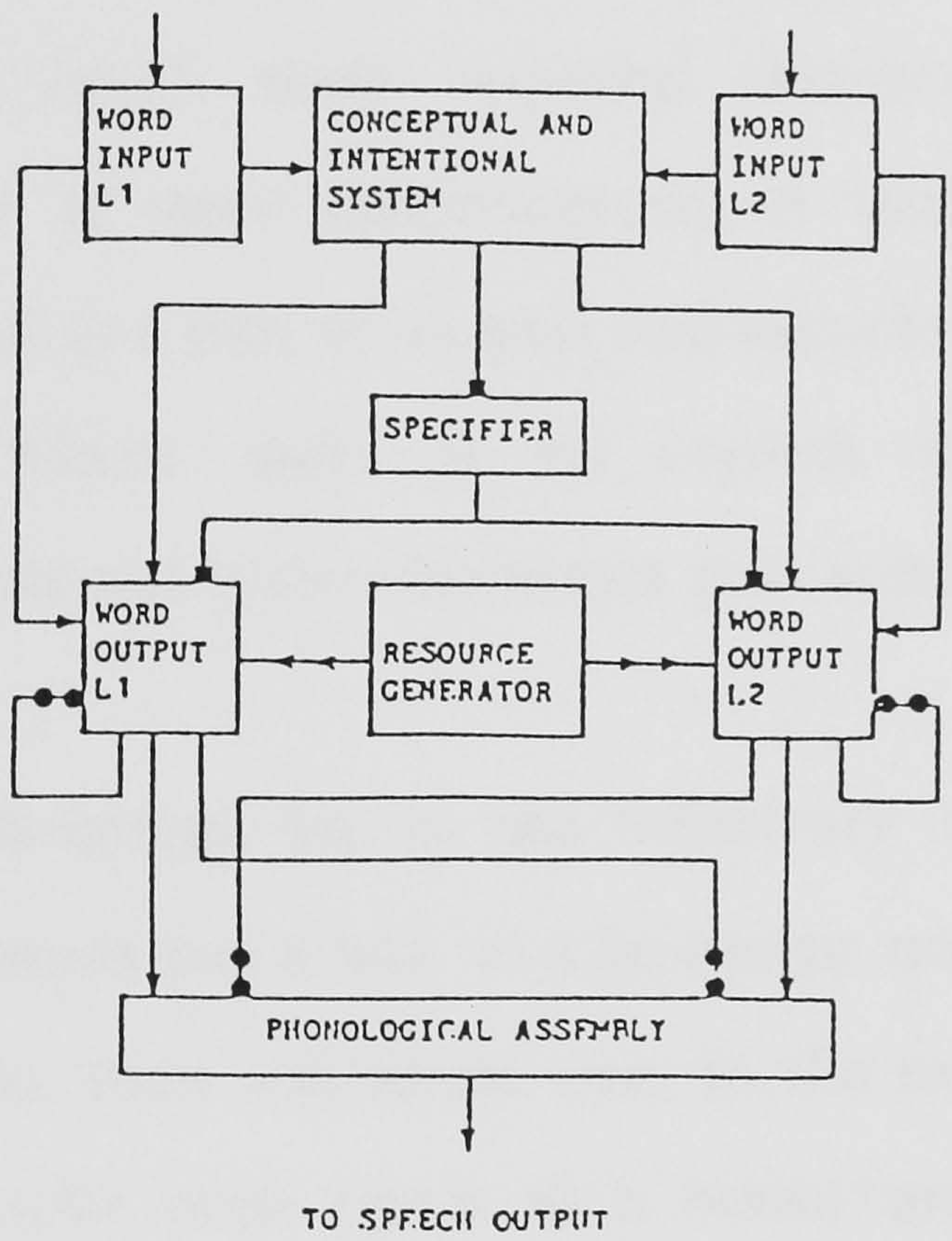


4.2.2. Green's (1986, 1998) Model

Green (1986) developed his 'inhibitory control' model (Figure 4.3) around this idea of varying levels of activation, not only between languages but at the various components of the system - such as at the word form or word meaning. He has since enriched his original model (Green, 1998) by adding a general mechanism of attentional control that is independently motivated by general cognitive systems. Green assumes a bilingual's languages to be organised in separate sub-systems, which accounts for bilingual patients sometimes losing command of one language and not the other. Using normal and patient data, he argues that slips of the tongue are made through a lack of control and supposes that the effects of brain damage also occur as a function of this.

Green's model uses the notion of a schema to explain the procedural aspects of how bilingual speakers control the lexico-semantic system, in the manner of Norman and Shallice (1986) who used the notion in proposing that the selection of an intermediate-level action involved activating its schema above threshold. Schemas in the inhibitory control model involve language actions, such as naming a picture in one language rather than the other. Selection of a schema occurs with the activation of its node exceeding a particular threshold, with its activation affecting the flow of activation within the lexico-semantic system. The inhibitory control model holds lexical decision schemas or picture naming schemas in some circumstances, to mutually inhibit each another. Green's (1998) belief is that for lexical decision in L1 and for L2 there is a single generic lexical decision schema that can take different parameters, especially given the view that schemas can be seen as methods to achieve goals (Cooper & Shallice, 1997).

Figure 4.3. Green's (1986) Inhibitory Control Model



Following Norman and Shallice's (1980) work on non-verbal motor skills and the supervisory attentional system, Green distinguishes between three states of activation. Firstly, he proposes that a language system may be *dormant* when it is least used or unused. If one of a bilingual's two languages is *active* when it is in use in the ongoing processes but not necessarily spoken. This results in language interference in bilingual lexical decision tasks (Altenberg & Cairns, 1983) and in involuntary intrusions in speech production (Shannon, 1991). Thirdly, a language system is *selected* when it is controlling speech output. When a bilingual wishes to speak a particular language, it must be selected and thus become highly activated whilst the other language, although still active, must be suppressed. Green proposes the presence of a *specifier* which specifies how much control is required over each language. Code switches occur when there is no suppression of the other language so that there is a free output which only varies according to which words reach their activation threshold first. The translation process requires that both languages are active, but that one of the outputs is suppressed, a complex task regulated by the specifier. Although similar to Dell's (1986) ideas on a theory of spreading activation where words are selected as they reach their required threshold, Green's addition of a specifier renders it more advantageous. A language schema selects the language required as a part of its goal and tags check that responses meet the language goal. Where there is no explicit marker for language, the supervisory attentional system monitors goal achievement.

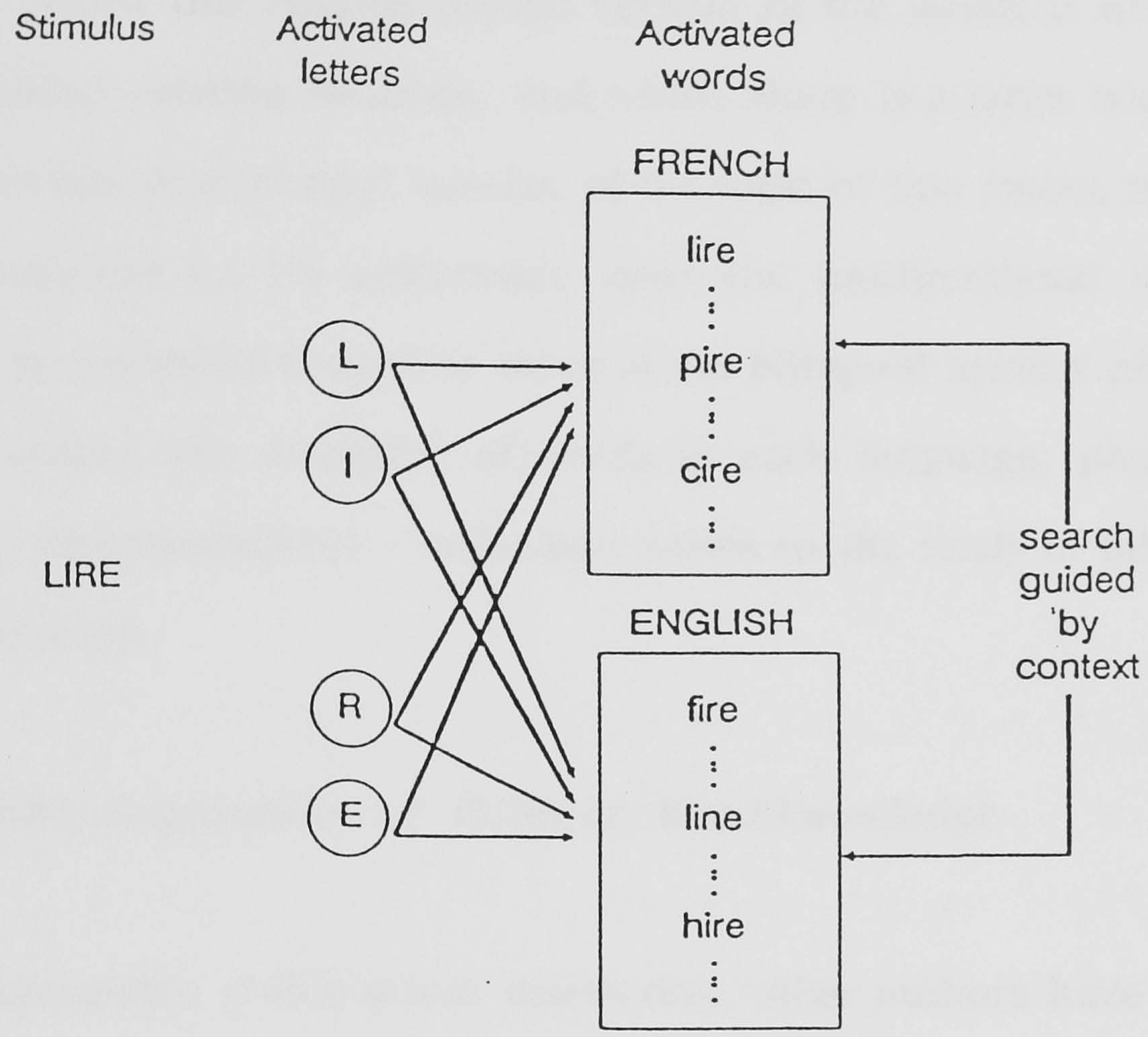
The rôle of the language tag in the inhibitory control model is in lemma selection. Each lemma has a link to a language node, this could be a network of neurones rather than one single one, in the same way that each lemma is linked to a syntactic node (such as a noun) and to a node specifying its grammatical gender (Schriefers, 1993). A word's language tag is the link between the word's lemma and the language node. This connection between a word and language node at the lemma level (and not at the orthographic representation level) holds certain implications. The lexical decision task, for example, is based on the activation of this lemma-language node link but patterns of activation of the orthographic system might also affect lexical decision time. Dijkstra, van Jaarsveld and ten Brinke (1998) examined lexical decision times to interlingual homographs such as 'angel' which also means 'sting' in Dutch, and found longer reaction times for these compared to control words when real Dutch words were included as items in English-specific lexical decision. Green argues that a single Dutch word would suffice to shift the Dutch lexicon from being in a dormant to an active state; with instructions to expect a Dutch word being enough to activate the system. In this task, once the Dutch lexicon is active the lexicon decision schema for English receives contradictory information through the Dutch lemma of the interlingual homograph, and so the longer reaction times occur because of competition at the lemma level. This viewpoint postulates that a lengthening in reaction times would occur for tasks involving responses that are selected in terms of language, because "...then selection at least involves inhibition at the lemma level" (Green, 1998). A semantic task, such as one where participants must judge whether a word refers to an animate or inanimate entity, would not show this switching cost. According to Poulisse (1997) and Schreuder and Hermans (1998) one of the main problems with Green's proposal is the fact it is somewhat general and linguistically too simplistic, omitting detailed descriptions of some processes involved such as of morphophonological encoding.

4.2.3. A Bilingual Interactive Activation Model - Grainger and Dijkstra (1992)

Also related to Dell's (1986) ideas on spreading activation, is the Bilingual Interactive Activation model (BIA) proposed by Grainger and Dijkstra (1992) (Figure 4.4). This model appertains to visual word recognition, working on the basis of nodes in the same manner of McClelland and Rumelhart's earlier (1981) studies, with units being activated in parallel rather than serially as in the models discussed so far. The BIA comprises of letter, word and language nodes, connected between and within levels.

As with McClelland and Rumelhart's (1981) monolingual version of this model, the word *cat* is connected to the letter nodes *c*, *a* and *t* and to the word node for *mat*. This is also consistent with Paap, Newsome, McDonald and Schvaneveldt's (1982) activation verification model.

Figure 4.4. Bilingual Interactive Activation model (BIA) - Grainger and Dijkstra (1992)



The extra set of language nodes specifies that the language spoken in this example is English. In one version of the model, activation spreads unidirectionally from letter to word to language units only, but in another version, activation is allowed to spread bidirectionally. Grainger and Dijkstra (1992) cite evidence in favour of this bidirectional version. In bilingual lexical decision tasks, faster reactions were found when target words were preceded by words of the same language or when a same language prime was used; results explained by activation of the language node by preceding words being spread to the word nodes, so that words of the same language take less time to recognise as the language node has already been activated. Evidence to support the simultaneous activation of both languages was also presented by the same authors, who showed that French-English bilinguals in an English, monolingual lexical decision task showed longer reaction times to words with more French than English neighbours. This would not occur if one language were completely inhibited whilst the other completely selected. Whilst this (bidirectional) version of the model is highly efficient in explaining existing findings, and whilst there is a large body of evidence to support the monolingual version of the logic of this model, much research is still required for its preference over the unidirectional version and it needs to be expanded to explain more of the bilingual speech process, such as lexical content, the structure of words in each language, phonological and semantic representations - important issues in the study of bilingual lexical representation.

4.3. Possible Organisation of Bilingual Word Knowledge

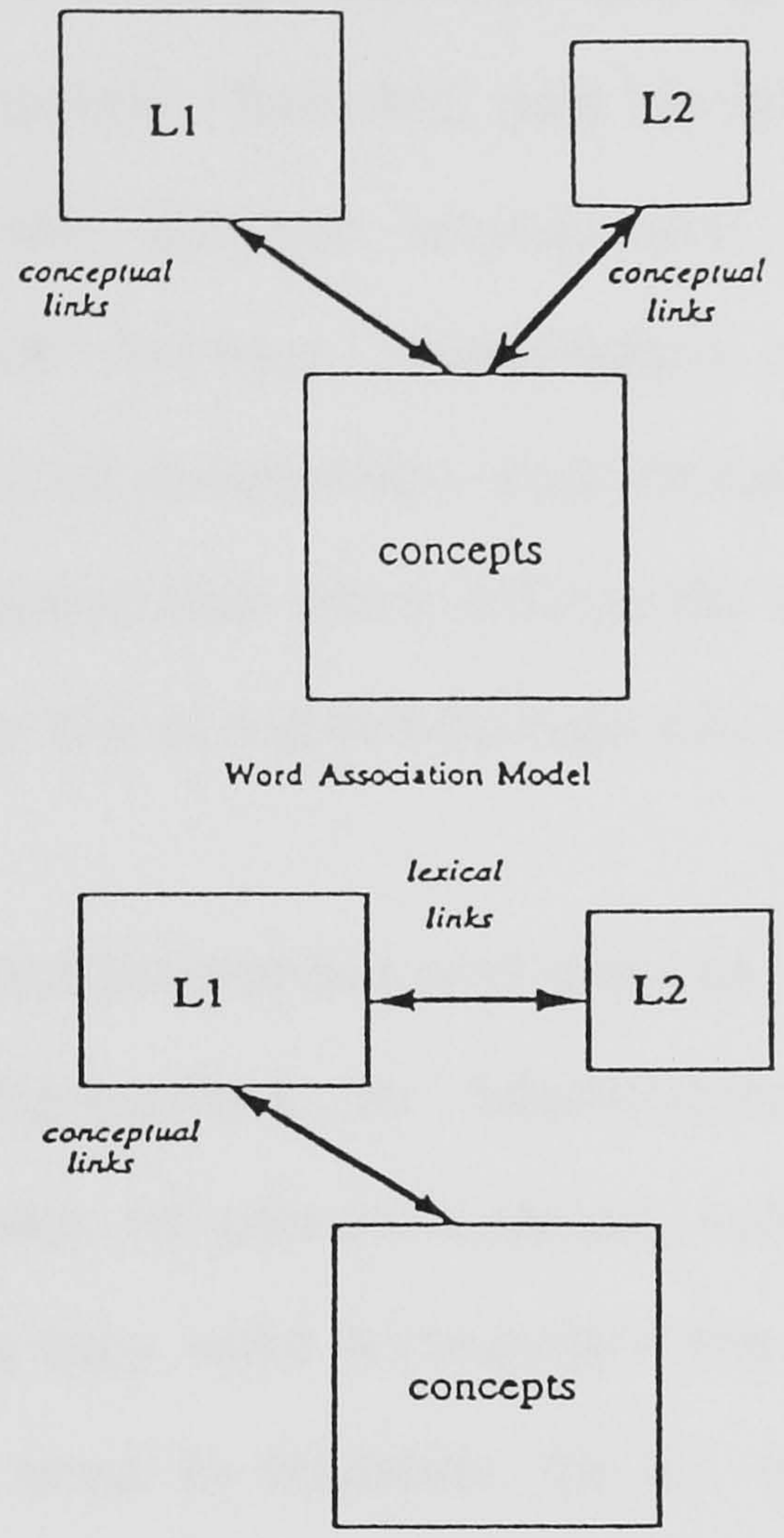
Since Weinreich's (1953) initial distinction, other authors have described the same organisations using different terms with most configurations suggesting a shared set of amodal, language-free conceptual representations.

Of the three configurations, the subordinative system has been granted less attention in the literature with the distinction between co-ordinate and compound bilingual storage also being referred to as 'separate storage' versus 'shared storage' (Kolers & Gonzalez, 1980) as 'independent' versus 'interdependent' systems (Vaid, 1988; Jin, 1990). De Groot (1993) points out that these terms are not only confusing but may also be rather detrimental. Many papers pose a dichotomous, either-or view, favouring one over the other, for example, Kolers (1963) who prefers the co-ordinate system, and so authors have been split as to which arrangement they agree with.

Durgunoglu and Roediger (1987) identify how various retrieval demands of tasks may lead to different results and opposite conclusions. They differentiate between explicit, conceptually-driven tasks (such as free recall) which yield results supporting a compound system and implicit, data-driven tasks (such as lexical decision) tasks which support a co-ordinate view, or one of common semantics and separate lexicons. Thus, results tend to support a compound system when performance is not dependent on the language of study items, but a co-ordinate system when performance *is* dependent on the language of study items; which may be supported by some of the findings in lexical decision studies (Kirsner, Brown, Abrol, Chadha & Sharma, 1980; Scarborough, Gerard & Cortese, 1984).

The same bias in results occurs when distinguishing between compound and subordinative storage. These two configurations have also been referred to as 'concept mediation' versus 'word association' storages (see Figure 4.5) with both configurations postulating a hierarchical organisation between two levels of representation - a conceptual and a lexical level - and a separate lexicon for each language. Although the lexical systems are independent of one another, they are interrelated via their connections to the common conceptual memory system. These experiential, conceptual mental representations are language independent and differ from lexical meanings which are language dependent. According to Potter, So, von Eckardt and Feldman (1984) the concept-mediation (compound) configuration proposes that the amodal, conceptual system connects the two lexicons of a bilingual but with the word association (subordinative) configuration the two equivalent words in each language are directly associated. Experiments examining the plausibility of either of these two models and organisation of the bilingual lexicon employ a variety of strategies, including comparisons of processing times, cross language stroop and lexical decision tasks, and semantic and repetition priming.

Figure 4.5. The Concept Mediation and Word Association Models (Potter So, von Eckardt & Feldman, 1984)



4.3.1. *Comparisons of Processing Times*

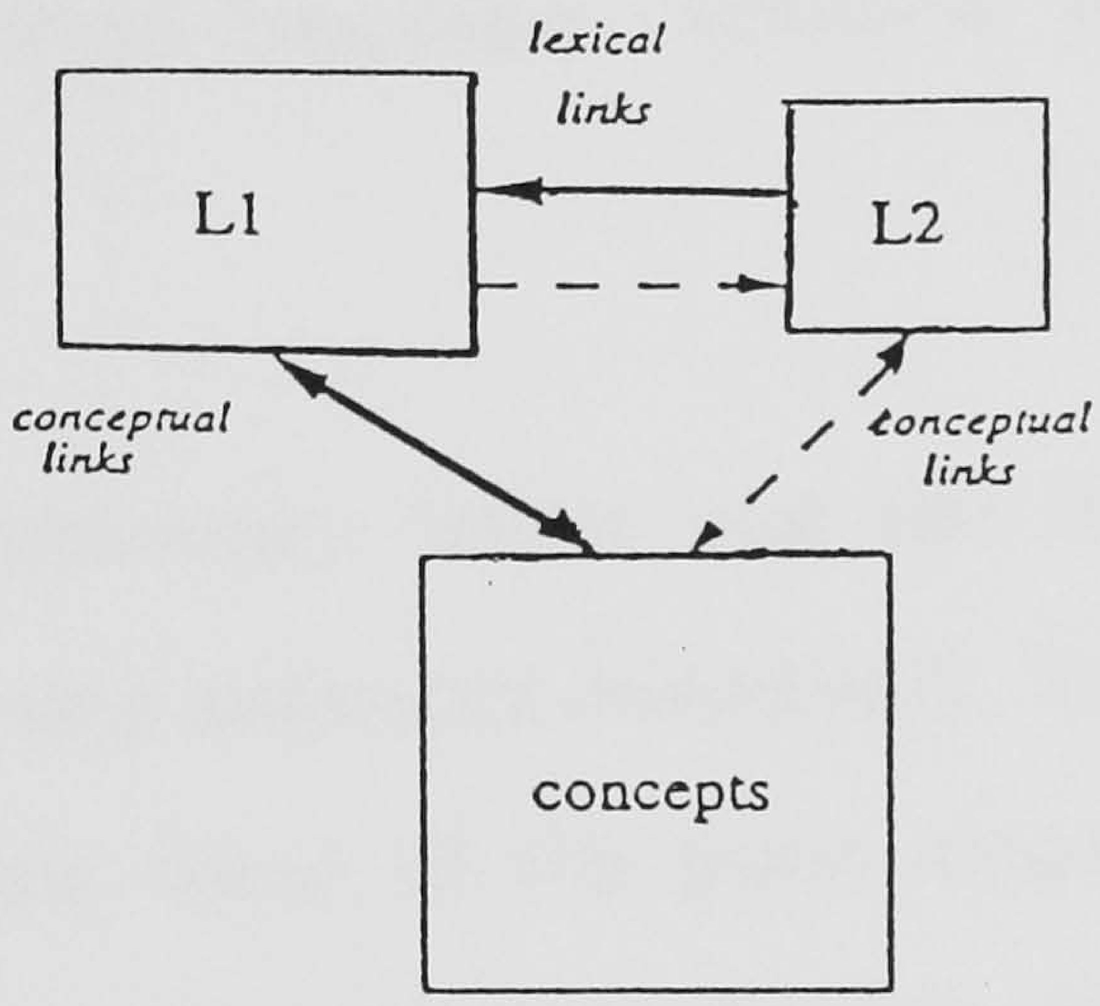
The differences found in processing times between monolinguals and bilinguals is not surprising, given that the vocabulary of a bilingual must be considerably larger than that of a monolingual by definition. Various authors have taken these differences to mean that bilinguals have two separate stores of words to choose the required one from. Kirsner, Brown, Abrul, Chadha and Sharma (1980) found that Hindi-English bilinguals took longer in intralingual lexical decision tasks than monolinguals as did Mägiste (1979, 1980, also 1982, 1986), who found that English/German and

Swedish/German bilinguals took longer than monolinguals in monolingual processing. Mägiste (1979, 1980) even found that bilinguals were slower than monolinguals but faster than trilinguals. She argues that this is because bilinguals have to choose from more language specific 'tags' and interference from competing language systems occurs. Mägiste suggests that bilinguals and trilinguals may be slower as they have less automaticity in each language, having had less time to practice the processing of each language separately. Ransdell and Fischler (1987) obtained similar, if less magnified results between monolingual and bilinguals, and concluded that their difference between monolingual and bilinguals occurred because a data driven (word recognition and lexical decision) task was used, and they agree with Mägiste that since bilinguals take less time processing their first language, they are at a disadvantage when performing this type of task.

In terms of word association and concept mediation, Potter et al. (1984) tested the two configurations by administering various tasks and comparing processing times. In picture naming, subjects were just as fast to provide a name in L2 as they were to translate the name from L1 to L2, showing that they did not need to translate an L2 picture name into L1 to access its conceptual representation. There was no difference in processing times for item categorisation regardless of whether category and item were in the same or different languages, consistent with Caramazza and Brones' (1979) findings. Potter et al.'s findings extend to proficient and less-proficient bilinguals, demonstrating that L2 words are still linked to the conceptual store even for less-fluent bilinguals. Instead, Kroll and Curley (1988) argued that early learners of a second language - bilinguals who were far from expert but beyond an early critical period of second language acquisition - access translation equivalents in order to access conceptual representations and suggested that Potter et al.'s less proficient beginners were more fluent than their group. According to Chen and Leung (1989) these early language learners access the conceptual store via first language mediation, different to fluent bilinguals who appear to have direct access to conceptual representations.

Kroll et al. (1988) pointed out certain issues that cannot be accounted for by either of the two word association or concept mediation hypotheses without making additional assumptions. Tasks reflecting semantic processes were found to be consistent with the concept mediation configuration but tasks using lexical processes are were not. They found in English-German bilinguals (like Kroll & Stewart, 1989 and, using Dutch-English bilinguals, Kroll & Stewart, 1990) that performance was faster and more accurate in translating from L2 to L1 than from L1 to L2. Kroll and Stewart (1990) postulated that this translation asymmetry reflected differences in reliance on lexical and conceptual mappings. Translation into L2 requires concept mediation whereas translation into L1 could occur via lexical mediation from L2 to L1. This lead them to argue that lexical links from L2 to L1 are stronger than those from L1 to L2, especially where acquisition of the second language occurs after childhood, while conceptual links for L1 are stronger for those for L2 (see also Kroll & Sholl, 1992) and they proposed the revised hierarchical model of bilingual memory representation (Figure 4.6). As their evidence for the model, Kroll and Sholl cite evidence from asymmetry in the magnitude of semantic priming, shown in studies where priming characteristics were carefully controlled so that only the automatic aspects of processing were measured (Neely, Keefe & Ross, 1989, discuss this in more detail). These studies show significant priming from L1 to L2 but less (Altarriba, 1990) or no priming from L2 to L1 (Keatley, Spinks & de Gelder, 1990), even with highly fluent bilinguals. Sholl, Sankaranarayanan and Kroll (1995) used a transfer paradigm to look at picture naming and translation. Using English-Spanish bilinguals, they asked subjects to name pictures and then translate words in both L1 and L2, repeating the concepts for some words. Although reliable transfer was found from L1 to L2, none was found for L2 to L1, which the authors conclude supports the claim that connections in bilingual memory are asymmetrical, with translation conceptually mediated from L1 to L2 but lexically mediated from L2 to L1.

Figure 4.6. A Revised Hierarchical Model of Bilingual Memory (Kroll & Stewart, 1990)



4.3.2. Cross Language Stroop Task Findings

The monolingual Stroop task originally required subjects to read colour names printed in different inks congruently (colour of ink and colour name are the same) or incongruently (colour of ink and name are different) and responses are usually faster in the incongruent condition. In the bilingual version, the word name is printed in the subject's first language with the response in the second language or vice versa.

The first Stroop task findings (Preston & Lambert, 1962) showed significant cross-language interference, but more within- than cross-language interference. This was dependent on proficiency of the bilingual and similarity of name across both languages (i.e. the more similar the name across both languages, the greater the interference produced). Studies by Dyer (1971); Albert and Obler (1978) and Fang, Tzeng and Alva (1981) yielded the same results. The latter study included, in a series of experiments, languages written in different orthographies and found an increase in cross-language interference when orthographies were similar. Hamers and Lambert (1972) also found interference across languages when an auditory version was utilised, and Ehri and Bouchard-Ryan(1980) also found more interference in a within-language condition when a picture-word version was employed.

In her work on proficiency levels and the Stroop task (1984; 1985; 1986) Mägiste found that with balanced bilinguals, between-language and within-language interference were of the same magnitude, again concluding that amount of experience of processing in each language was the determining factor in performance. Using Chinese-English bilinguals at various levels of proficiency, Chen and Ho (1986) always found greater interference within languages when Chinese (L1) was the language that subjects had to name ink colour in. When English (L2) was the response language, greater amounts of within-language interference was found with more proficient bilinguals whereas more cross-language interference was displayed by beginner English speakers, results which were taken to support the concept mediation model.

4.3.3. Lexical Decision Task Findings

In a monolingual lexical decision task, subjects are presented with a list containing real words and nonwords, created by changing one or two letters of a real word. Bilingually, the task allows one to see if the speaker is able to make lexical decisions for words in a selected language whilst completely ignoring words in the non-selected language. If participants reject words in the non-selected language at the same rate as nonwords, they are able to function in one language whilst completely shutting out the other. If, instead, subjects are slower at rejecting words from the non-selected language than nonwords, they are processing the non-selected language words and are unable to switch off the non-selected language.

Nas (1983) employed this task asking bilinguals to make lexical decisions for words in their second language. Real words from the participants' second language were used, and conventional nonwords were inserted to distract the real words from the first language as well as nonwords which were homophones with real words when read using the phonology of the first language. It was found that participants were faster to respond to the conventional nonwords, results replicated by Altenberg and Cairns (1983) in a similar study. Nas concluded that his results supported a shared lexicon configuration, but Altenberg et al. suggest that in this task all of the language-specific processing systems are being activated simultaneously. Scarborough, Gerard and Cortese (1984) compared monolingual English participants' results with those of English-Spanish speakers and found both groups to reject nonwords which were actually real Spanish words, at the same rate. They took these results to mean that bilinguals can select or deactivate knowledge of one language system or the other. Similar findings were reported in a study by Gerard and Scarborough (1989). However, these studies did not control for word frequency and for ignorance of Spanish in the monolingual group - the monolingual participants had "at most, a single high school Spanish course". Even by taking a few Spanish lessons, subjects could have gained knowledge of some high frequency Spanish words.

Finally, Altarriba and Mathis (1997) carried out translation judgement and Stroop tasks to explore Kroll and Stewart's (1994) revised hierarchical model, using novice second language acquirers. Monolingual subjects who had never learned Spanish were taught a set of Spanish-English translations and this set of 'bilinguals' was compared to expert bilinguals. According to the model, a link between L2 words and their conceptual representations develops with second language proficiency. The model predicts that a novice speaker would be affected by lexical or orthographic interferences only, whereas fluent bilinguals would be affected by interference at lexical and conceptual levels of language representation. They found that response times to orthographically similar words were longer than those for unrelated words and there was less lexical interference for expert bilinguals. Interference at a conceptual level of representation was found but this was greater for expert bilinguals. They found within- and between-language Stroop effects for both novice and expert bilinguals. The results contradict Kroll and Stewart's (1994) conclusions that novice bilinguals rely solely on lexical representations when learning a second language, and Altarriba and Mathis conclude that both conceptual and lexical links are formed for L2 words, even after one learning session.

4.4. Semantic Priming and Related Semantic Tasks

Semantic or associative priming is an experimental technique whereby a single encounter with a familiar word can facilitate later recognition of a related item, for example, recognising the word *doctor* primes the word *nurse*. It differs to repetition priming which is where an encounter with a familiar word can facilitate its recognition later, so seeing the word *doctor* early on in a set of items facilitates production of *doctor* later on. Repetition priming is long lived and is modality-specific whereas semantic priming is short lived and can cross from one perceptual field to another.

Semantic priming effects have often been attributed to the spread of activation between memory nodes. When a presented word corresponds to a representation preactivated through activation spread from the presentation of an earlier prime, it is recognised and responded to faster than if it were presented alone or without a related prime (Collins & Loftus, 1975; Masson, 1991). The first semantic priming experiments were performed by Meyer and Schvaneveldt (1971); Fischler (1977) and Neely (1977); and Neely (1991) provides a review of these. As de Groot and Barry (1992) note, two other processes contributing to the effect have been found under appropriate circumstances. Tzelgov and Eben-Ezra (1992) describe the 'expectancy (or 'attentional') mechanism' that focuses the participant's attention on a specific zone of the semantic network leading to a facilitation in processing in that zone. The second process they mention is the 'post-lexical checking process' also mentioned by Keatley and de Gelder (1992) as 'post-lexical meaning integration'. This is where subjects attempt to relate the meanings of both prime and target after presentation and can slow down or speed up responses according to the outcome of the process. The two studies examine the contribution of spreading activation to cross-language priming by disabling these processes of expectancy and post-lexical checking and by comparing the amount of priming obtained under circumstances which are favourable or unfavourable to produce these processes.

Cross-language priming studies have found semantic priming between languages (Meyer & Ruddy, 1974; Schwanenflugel & Rey, 1986; Chen & Ng, 1989; Tzelgov & Henik, 1989; Altarriba, 1990; de Groot & Nas, 1991) but no repetition priming (Scarborough, Gerard & Cortese, 1984; Kirsner, Smith, Lockhart, King & Jain, 1984; Gerard & Scarborough, 1989). Another main finding is for semantic priming to occur across as well as within languages for proficient bilinguals (Meyer & Ruddy, 1974, Kirsner et al, 1984; Schwanenflugel & Rey, 1986) similar to findings that cross-modal priming is comparable between words and pictures (Kroll, 1990; Vanderwart, 1984 - findings which have been reported in the monolingual literature).

Some of the studies showing semantic priming suggest that the amount of between-language (interlingual) semantic priming is as large as the amount found within languages (intralingually) (Meyer & Ruddy, 1974; Schwanenflugel & Rey, 1986 Experiment 2; Chen & Ng, 1989; Tzelgov & Henik, 1989). Kirsner et al. (1984) found substantial semantic priming from between- and within-language primes. In some conditions (Experiment 4 with English-Hindi bilinguals) they found equal semantic priming effects within and across languages although Experiment 5, using English-French bilinguals showed greater priming within than between languages.

It has been found (Jin & Fischler, 1987; de Groot & Nas, 1991) that between-language priming may be dependent on word type. Jin et al. found between-language priming for concrete words but none for abstract words. They also found greater priming for translation equivalents - that is, the more dominant the translation of the L1 word into L2 (and vice versa), the greater the amount of semantic priming expected, based on the assumption that translating is mediated by semantic representations. The model proposed by Kroll and Stewart (1994) however, assumes that second language words are learned by being directly linked to words in the first language which could mediate translation between languages with no semantic involvement and so with no priming in these links.

According to Grainger and Beauvillain (1987) the shared conceptual representations across languages results in subjects forming predictive strategies, depending on the stimulus onset asynchrony (SOA) of target and prime. As Altarriba (1990) points out, if the SOA is too long, it allows enough time for translation of the prime. Chen and Ng (1989) in their findings of equal within- and between-language priming using a lexical decision task, used an SOA of 300 ms between prime and target. Bilinguals were presented with a 30-item block of Chinese-English pairings and with another block of 30 English-Chinese pairings and were required to guess whether the target was a word or not. Greater amounts of priming were found when the prime was a translation equivalent than when it was an unrelated word from the same language, a bias explained by the too-long SOA. In a primed lexical decision task which combined effects of proportion of related prime-target pairs and SOAs of prime and target, de Groot (1984) reaction times averaged over 800 ms in the translation condition, which is somewhat longer than the standard 600-700 ms average previously reported (Neely & Keefe, 1989; Neely 1990) suggesting an influence by strategic processes by subjects.

Jin (1990) examined effects of translation priming, this time using shorter SOAs, in a Korean-English lexical decision task using blocks of 50 English-Korean and 50 Korean-English word pairs. An SOA of 150 ms was employed between prime and target. Again, this was a lexical decision task, so participants had to decide whether or not the target was an existing word, but word-word pairs of items consisted of translation equivalents, associates and unrelated word pairs. Significant priming effects were found for translation equivalents compared to unrelated targets, and the effects were significantly greater for Korean-English than for English-Korean pairs. Altarriba (1990) indicates another methodological problem to consider in studies of this nature - that of proportion. Jin's study contained a high proportion of related prime-target pairs in the stimulus lists. De Groot (1984) found that the larger the proportion of related prime-target word trials, the greater the semantic priming. Tweedy and Lapinski (1981) report an increase of the priming effect with increased related pairs, and a decrease of the effect with decreased numbers of related pairs, as subjects come to expect a relationship between the prime and target of a pair and are thus quicker to respond 'yes' to the two being related. The stimulus lists used in Jin's study also had a high word-nonword ratio, which may have biased responses and induced various strategies of responding.

4.5. Repetition Priming

The main finding of the studies in this field (e.g., Kirsner, Brown, Abrol, Chadha & Sharma, 1980; Kirsner, Smith, Lockhart, King & Jain, 1984; Scarborough, Gerard & Cortese, 1984) which supports language-specific stores for lexical representations, is that words repeated in the same language (repetition condition) but *not* in a different language (translation condition) resulted in shorter lexical decision times than unrepeated new words.

The existence of cognates between two languages gives rise to further exploration. The graphemic pattern of a word is non-language specific, as it may be almost or completely similar for words in both of the languages (e.g. *rico/rich* and *reunion/reunion* in Spanish and English). It is important to note here that cognates have different meanings according to different authors, an issue that Grosjean (1998) considers important in stimulus selection. The definition of a cognate word varies from author to author. Crystal (1991) defines cognates as linguistic forms which are historically derived from the same source as other language forms. Different authors have defined cross-linguistic cognates as being similar to different degrees.

De Groot (1995) for example, considers cognates to have similar graphemic forms across languages, whereas to Caramazza and Brones (1979) graphemic forms are identical, according to Sánchez-Casas, Davis and García-Albea (1992) there is a great degree of overlap, and Beauvillain and Grainger (1987) say the two are the same. The same issue arises with phonology between cognates: De Groot considers cross-language cognates to have similar phonological forms whereas Caramazza and Brones (1979) say it is different.

The separate lexicons theory assumes that there are different representations in one lexicon for each cognate word in each language, and so there would be separate representations for *reunion* as a spoken Spanish word and for *reunion* as a spoken English word and two separate representations for it as a written word. Instead, the shared lexicons theory (e.g. Monsell, Matthews, & Miller, 1992; Grainger, 1993; de Bot, 1992) assumes one phonological lexicon where phonological representations in both languages co-exist, and one orthographic lexicon where orthographic representations in both languages co-exist. This theory would propose one single phonological representation involved in producing and understanding the word *reunion* either Spanish or English, and one single orthographic representation for its written form. Work by Caramazza and Brones (1979) indicates that access to the representations for cognate words is entirely due to the pattern of orthography and not to language specific aspects. Their study used cognates embedded in a list of L1 or L2 words, or bilingual lists, and they found that unbalanced bilinguals responded at the same rate, regardless of which list was presented.

With regards to priming, the separate lexicons theory predicts that hearing or saying a word in L1 will prime the same word in L1 later, but not in L2, and hearing or saying a word in L2 will facilitate hearing or saying that same word in L2 later, but not in L1, as the two are stored separately and do not interact in any way. However, the shared lexicons theory, where some of the connections are used for both languages, predicts both within- and between-language priming. The same would be expected of homographic cognates.

A number of studies by Kirsner, Brown, Abrol, Chadha and Sharma (1980); Scarborough, Gerard and Cortese (1984 - Experiment 1); Kirsner, Smith, Lockhart, King and Jain (1984 - Experiment 1); Gerard and Scarborough (1989) and others have shown no cross-language priming for non-cognates under conditions where within-language priming was produced, which shows that repetition of meanings is not sufficient to generate repetition priming of lexical decision. These findings were reported by Monsell et al. (1992), who gave Welsh-English bilinguals spoken object names to Welsh-English definitions and then asked for them to be named in Welsh. They found within-language priming for non-cognates but did not find cross-language priming, hinting an inhibitory effect, and concluded that "...the L1 and L2 sets of semantic to phonological associations are not encapsulated in two different modules or pathways that can be turned on and off as a unit, but are captured in a single network of conductivity from semantic features to phonological features".

Kirsner et al. (1984) produced similar results to these authors, finding no between-language priming for non-cognates when subjects were required to write sentences containing prime words in a prime phase, and later tested using a semantic classification task. Kirsner et al. also found priming from translating non-cognates in the priming phase to lexical decision. Sánchez-Casas, Davis and García-Albea (1992) used cognates and non-cognates in a Spanish-English bilingual semantic categorisation task. Bilinguals were required to decide whether target words belonged to the category names in an immediately preceding question. Between question and target, a prime was masked so it could not be identified, with the relation between prime and target varied. The authors found priming for cognates but not for non-cognates, suggesting, as the authors of the previous studies mentioned, that cognates share a lexical representation whereas non-cognates are represented separately. Sánchez-Casas et al. also found that translating from L1 to L2 took significantly longer than from L2 to L1 when the words to be translated were non-cognates (replicating Kroll & Stewart's 1992 findings), and also explain these results by the existence of shared representations for cognates.

Cristoffanini, Kirsner and Milech (1986) reached these same conclusions - that letter pattern of word rather than language specificities determines lexical access. As with Gerard and Scarborough (1989) they found substantial cross-language priming between cognates but not non-cognates in Spanish-English bilinguals. Cristoffanini et al. (1986) claim that the amount of cross-language priming for orthographically identical cognates (*reunion/reunion*) is of the same magnitude as the amount for similar cognate words (*crueldad/cruelty).* In their study, they compare orthographically identical cognates with common stem cognates that have regular suffixes (e.g. -tion/-cion, as in observation/observacion), common stem cognates with irregular suffixes (e.g. *itinerario/itinerary*) and morphologically unrelated translations (e.g. *tristeza/sadness*); the sets of words were matched for frequency.

Beauvillain and Grainger (1987); Kerkman and de Bot (1989) and Gerard and Scarborough (1987) included 'false friends' in their studies - these are homographic non-cognates; words which look alike but which have different meanings across languages (e.g. list/list, where *list* in Dutch means 'trick'). Kerkman and de Bot found priming for cognates but not for non-cognates in Dutch speakers who were moderately fluent in English, but not in compound bilinguals. Gerard and Scarborough found priming between word pairs in a lexical decision task, but only when the phase 1 word was of low frequency in the phase 1 language and followed by a high frequency phase 2 word where the phase 2 language was the one for which priming was assessed. It seems likely that when a participant sees a word of low frequency in one language, (s)he cannot help but access its higher frequency in the other language. Indeed, Gerard and Scarborough's experiment shows considerable interference when the first encounter was of a high frequency English word and the second encounter was its low frequency Spanish version. Beauvillain and Grainger also used a primed lexical decision task, finding priming of these homographic non-cognates with a short SOA, but this disappeared when the SOA was lengthened. They conclude that when automatic language processing is occurring, the access of conceptual representations is guided by the frequency of the orthographic form rather than by language, for they also found an effect of frequency, with the frequencies of the homographic non-cognates determining the patterns of priming. These language-specific, orthographic cues are confounded with neighbourhood characteristics.

These conclusions are supported, partly, by findings from Grainger and O'Regan (1992) who applied a primed lexical decision task to themselves, manipulating orthographic neighbours. An orthographic neighbour, as defined by Coltheart, Davelaar, Jonasson and Besner (1977) and the definition the authors take, is any word of the same length, differing by only one letter from the stimulus; so the word *fire* has English neighbours *hire* and *fare*, and the French neighbours *lire* and *rire*. Grainger et al. (1992) used French words which had more English than French neighbours (they call these French 'traitors'), some which had more French than English neighbours (French 'patriots') as well as English words having more English than French neighbours (English 'patriots'), and their stimuli were matched for frequency. They still found priming to occur even after the two participants (i.e. themselves) had become familiar with the experimental stimuli, suggesting the priming effect to be highly automised and irrepressible. The effect was shown, at short SOAs, to be dependent on neighbourhood characteristics (that is, on the number of orthographically similar words in each language) of the prime, and at short SOAs, on the language of the prime.

Woutersen, de Bot and Weltens (1995) found repetition priming using an auditory lexical decision task, with Dutch-English proficient bilinguals. Priming between languages was present and the authors claim equal magnitude for cognate and non-cognate translations. The experiment was repeated with visual presentation and the same findings obtained. This led de Bot, Cox, Ralston, Schaufeli and Weltens (1995) to identify the three factors playing a role in lexical processing as being mode of presentation, level of proficiency of the bilingual's second language, and cognateness of the item used. Given Beauvillain and Grainger's finding of a frequency effect, it is important to manipulate not only an item's cognateness but also its frequency and other factors known to affect monolingual word processing such as familiarity and age of acquisition (Morrison, Ellis & Quinlan, 1992).

4.6. The Bilingual Population in this Thesis

This thesis concentrates on the Italian bilinguals in Great Britain. It is estimated that there are 200,000 Italians in England who entered the country for various reasons at different times (Cervi, 1991). Although a gradual increase may be traced from the mid-nineteenth century, the group of immigrants which will be of later concern to this study are those which arrived after the Second World War in 1945 with the mass recruitment of labourers to the brick-making industries in Bedford and Peterborough from Southern Italy (King, 1977). Where compound bilinguals are involved, the offspring of these Italian immigrants from Bedford were used. Cervi (1991) explains how areas of this mass recruitment resulted in formations of small groups, usually from the same village, communicating in the dialect of the village as well as in a more formal Italian. Due to Italy's late unification (1861), there is no geographically neutral accent in Italian and thus no equivalent of the British 'received pronunciation', and although a loose standard Italian exists, even the educated have different manners of pronunciation.

Using a homogenous population such as the one comprising of bilinguals from Bedford avoids many of the problems that Grosjean (1998) identifies as methodological issues in studying bilingual populations. The experimental groups of this thesis are comprised of participants from a homogenous population; young adults born of Italian parents in the UK. Individual variation is small, since the range in ages is small and since participants are from the same area of both the UK and of Italy. Many members of participants' families come from similar socio-economic backgrounds and are of the same educational status. We can be certain hence, that language proficiency, although also tested in both languages with the aid of pieces of text and pictures of objects with low frequency names for all participants, is of the same level.

The Italian language is of particular interest because it is regular in two manners. Firstly, it is orthographically regular. That is, a letter or a cluster of letters will always be pronounced in the same way, so the letter combination *gh* always possesses the same pronunciation, regardless of whether it occurs in *ghianda, spaghetti* or *lunghi.* This is different to the English language where pronunciations differ so the same letter combination is pronounced differently, as in *ghost, cough* or *bough.* Previous studies examining the detection of Italian surface dyslexia and the effect of the transparency in Italian surface dyslexics (such as Job, Sartori, Masterson & Coltheart, 1984) have concluded that since Italian stress assignment is irregular (*orfano* is stressed on the first syllable, but *martello* on the penultimate and *libertà* on the final syllable), a test might be constructed for this instead.

Secondly, Italian is regular with regards to word gender. Nouns ending with *a* (*ragazza, porta, anatra*) are usually feminine whilst those ending with *o* (*ragazzo, libro, albero*) are usually masculine. Nouns which end with *e* may be either masculine or feminine (*il mare* is masculine whilst *la nave* is feminine). In terms of Levelt's model, knowledge of an item's gender is encoded in the lemma.

Furthermore, a population which speaks the Italian language is of particular interest as it allows us to examine how the transparency (Italian) or opacity (English) of an orthography might affect written and semantic knowledge. Dual-route models of reading (such as that of Coltheart & Rastle, 1999) propose that it is possible to read words aloud non-lexically, and sub-lexically by employing a set of spelling-to-sound conversion rules. English has a deep orthography with highly inconsistent spelling-to-sound conversion rules, and regular words may be pronounced correctly by grapheme-to-phoneme correspondence (GPC) rules. However, applying GPC rules to irregular words would lead to an incorrect pronunciation of irregular or exception words. As

Italian comprises of a shallow orthography with high grapheme-to-phoneme correspondences, errors of this nature would not be made. Plaut, McClelland, Seidenberg and Patterson (1996) suggest that two pathways, the *phonological* and the *semantic pathways* are necessary in reading, since different tasks must be performed. The *semantic pathway* transforms orthographic representations into semantic representations (for example, helping the English speaker to decide between *rain* and *reign*) and transforms semantic representations into phonological representations. However, given that there are no phonological, non-homographic cognates in Italian because of its regularity, this contribution from the semantic system would not be required for reading aloud.

Finally, there is much value in the studying of bilinguals overall. The domain of bilingual object naming is a rich source for insight into bilingual cognitive processing, especially where bilingualism entails the study of two languages containing words which are very similar (i.e., cognates) and very different (i.e., non-cognates). Bilingual research of the type included in this thesis provides opportunity for testing models of object and word recognition developed from the monolingual data, and allows for the scope to validate and possibly extend the underlying theories of bilingual lexical processing. Cross-language comparisons of performance allow for investigation into which aspects of lexical processing are language specific and which are universal. Moreover, the availability of a bilingual population allows for thorough testing in both languages of a bilingual aphasic (as will be described in Chapter 7). and the opportunity for provision of detailed medical history and testing of other aspects of cognitive function. The study of language breakdown in bilinguals to date has been hampered by lack of formal testing and incomplete details of medical history and language background and many theories have been based on partially documented case reports, rather than case reports being related to existing theory.

The next chapters therefore involve exploration of the bilingual lexicon both in its composition and in its breakdown, by using reaction time studies from normal participants naming cognate and non-cognate items, and by reporting a detailed case study of a bilingual aphasic.

Chapter 5

Bilinguals' Processing of Near- and Non-Cognate Picture Names

5.1 The Cognitive Price of Communicating in Two Languages

"...Foreign languages take up much time even after they have been learned, and may lead us once more to weigh the gain and loss of a polyglot mental life" Cattell (1887)

The first psychological studies of bilinguals were performed by Cattell (1887) who suspected that learning a second language might interfere with the speed of association between concepts and words in the first language. In comparisons of processing times in first and second languages using the tasks of object naming, word naming and translating concepts, he found that more time was required to name objects in the second language and also that more time was taken to translate in either direction than to name objects. This led Cattell to conclude that bilinguals pay a cognitive price for their ability to communicate using two languages.

The next studies on bilingualism did not appear until the 1950s with Weinreich's (1953) distinctions between compound, co-ordinate and subordinate bilinguals. There followed a body of literature on bilingualism, such as Kolers (1966) who asked participants to read passages of text aloud under conditions where bilingual text was mixed. Although comprehension was not affected, bilinguals were slower at reading mixed-language text. According to Kolers, this occurrence was due to bilinguals having meanings of words represented in language-free form in long term memory, but the presence of a language switch mediates between representations of language-specific stimuli, and so it is the functioning of this switch that results in the extra processing time required.

Oller and Tullius (1973) compared processing times of native and non-native (but fluent) participants reading text in English. Non-native readers showed the same number of fixations and regressions as native readers but their fixations were much longer, suggesting that bilinguals take more time to process symbols in their second language. Similarly, Marsh and Maki (1976) found that bilinguals performing arithmetic operations were faster in their preferred language.

Beauvillain (1992) reviewed a number of studies and concluded that the reason why bilinguals are faster at reading passages of text composed of words from one language only than at reading passages of words from both languages, is because the bilingual lexicon is structured to allow access to one language at a time only. Soares and Grosjean (1984) observed that bilinguals took longer to make lexical decisions when they were in bilingual mode than when they were in monolingual mode, and they interpret the longer processing time to result from the switching from one language to the other and also from the added load of activating one processor whilst de-activating the other. However, another explanation is that there is some cost associated with activating two lexicons as compared to activating a sole lexicon (if one is to posit an arrangement where the two languages of a bilingual are contained within separate stores). If it were possible to limit activation and search to a single lexicon, we might expect results identical to those of a monolingual in tasks such as lexical decision. Instead, we are presented with findings such as those of Ransdell and Fischler (1987) who found that adults who had been bilingual all their lives were slower at responding on list recognition and lexical decision even though they were as accurate as monolinguals performing the same tasks. The authors explain this by the fact that the tasks are data-driven and because bilinguals spend less time processing their first language than they would if they were monolingual.

Mägiste also reports results where bilingual participants are slower than monolinguals. On tasks involving reading words, naming numbers, naming objects and stroop tasks it was found that the monolingual participants were faster than the bilingual ones, and furthermore bilinguals were faster than trilinguals. She concludes that "..the very fact of having available more than one response to the same stimulus may lead to slower reaction times unless the two response systems are hermetically isolated from one another".

According to Mägiste, bilinguals suffer this lengthening in response times as a result of competing language systems which occur whenever there are response alternatives and also because they have less time to practice processing in either language. The findings are also consistent with an arrangement where a bilingual's two languages are stored in a unitary store with distance between them: elements which are different are stored separately and away from each other but those which are the same are stored closer together and may even overlap (e.g. Grainger & Dijkstra, 1992). This viewpoint would account for the longer reaction times in that for certain concepts the bilingual has more than one lexical representation, but for other aspects which are similar across languages representations are shared. The aspects of word processing which would therefore be important for us to distinguish between the theories of shared or separate lexicons would be these aspects which are shared across languages: namely, cognate words.

Cognates are words which look and sound the same (or similar) across two languages. For an English-Italian bilingual, for example, the word orchestra looks the same and almost sounds the same in both languages, as does the cognate pair *letter* - *lettera*.

As apparent from the studies mentioned so far, the models in the literature envisage a range of different possible relationships between a bilingual's two languages. Most propose the existence of a common set of conceptual or semantic representations, which are amodal and language free. For example, the knowledge of what a pencil is - what it is made from and what it may be used for - is nonverbal knowledge which can be accessed from seeing a pencil, or from hearing or reading its name in any language. The debate arises over lexical content and structure of the two languages of a bilingual. 'Separate lexicons' theory holds that phonological word forms of the two languages are held in separate lexical stores, as are the orthographic word forms. In this type of model there would be four types of representation: pictorial (which must be activated if an object or picture is to be classified as familiar), semantic (which must be activated as well as the pictorial representation the object or picture is to be classified semantically and to be named), and phonological and orthographic representations. Spoken object naming requires that the semantic representation should, in turn, activate the phonological representation of the appropriate spoken word form. Recognising a spoken word involves activation of a phonological representation from an external source (a heard word), whilst understanding it requires activation of semantics from phonology. Instead, reading and writing involve activation of orthographic representations from print (reading) or from spelling and writing. In a framework such as this, for an English-Italian bilingual, the representation of the spoken word *pencil* would be in the English phonological lexicon, and a separate representation of *matita* (its Italian translation) would be in the Italian phonological lexicon. Similarly, the representation for the written word form *pencil* would be in the English orthographic lexicon, and the representation of *matita* in the Italian orthographic lexicon. This separation would even extend to words which look and sound the same or similar across the two languages, so *letter* and *lettera* would be duplicated in the two phonological and two orthographic lexicons.

An alternative to the separate lexicons theory is a view where the phonological representations of words in a bilingual's two languages co-exist in a single phonological lexicon, while the orthographic representations co-exist in a single orthographic lexicon. Similarly, another theory one where some representations co-exist but other representations are duplicated in the phonological and once more in the orthographic lexicon, depending how similar and different the two are across languages. One problem in the literature is that the term "shared storage" has several interpretations. It may refer to complete co-existence for the two languages, or to co-existence with partial separation. In this latter arrangement, very similar or identical elements from the two languages would be represented once but very different items would be represented separately for each language.

Cognate words are an important class of words for distinguishing between these alternatives. If cognates do show evidence of having representations which are shared across languages, it should be possible to see them being named faster because it is not the case that two separate lexicons or representations require activation in their naming. It should also be possible to see evidence of their facilitation with increased presentation - that is, one should see repetition priming for cognate words.

If Mägiste's accounts for bilinguals' longer reaction times are examined further, there several issues that must be addressed. Firstly, taking the argument that bilingual reaction times are longer because of competition effects between words expressing the two meanings in both languages: it has been established in the monolingual literature that objects with multiple names (e.g. *couch, sofa, settee*) are slower to name than objects with one or very few names (Lachman, 1973; Lachman, Shaffer & Hennrikus, 1974; Vitkovitch & Tyrrell, 1995). A name agreement effect in bilinguals could be caused by an inability to totally inhibit one of the languages - the effect would disappear if the other language could be switched off completely. This explanation is also consistent with Mägiste's finding that trilinguals are slower than bilinguals. In this case, lengthened reaction times would be due to trilinguals showing competition effects between a minimum of three representations per concept. This name agreement explanation also predicts that word names which are similar across languages - that is, cognate word names - should be easier to produce since little or no competition should occur.

The alternative explanation given by Mägiste for longer reaction times from the bilingual participants in her findings, is based on the notion that the frequency with which bilinguals use either language is less than that of a native speaker of either language. That is, even if bilinguals are seeing a given object as many times as a matched monolingual, they only name it in the monolingual's language half the time. This has certain implications for bilingual research. In the past, studies involving bilingual naming has typically employed items which are matched on frequency using *monolingual* counts (e.g. Cristoffanini, Kirsner & Milech, 1986, which used the Kucera & Francis' (1967) word count for English and Juilland & Chang-Rodriguez (1964) for the Spanish counts). Even the experiments reported in this thesis employed monolingual frequency counts to match for frequency across languages for each of the two languages. However, if bilingual word frequency does operate in a different manner to monolingual word frequency, separate ratings and measures should be obtained from bilingual participants for future studies.

An important point to note here is the importance of using *balanced* or *compound* bilinguals. That is, participants who are equally proficient in both languages. Such bilinguals may have a dominant language, or may use one in some contexts and the other in others, but they are equally fluent in either. This is of particular importance in the following studies, given that "...the rate at which a person can read a foreign language is proportional to his familiarity with the language" (Cattell, 1887).

Although the tasks mentioned demonstrate that bilinguals are slower at processing in their second language, they do not provide evidence for whether bilinguals are slower or the same as monolinguals at processing their *first* language. As Grosjean (1985) points out, studies into language acquisition have often focused on the growth and development of the new language store, without referring to "..what happens concurrently to the first language as it restructures itself in contact with L2". Research of this nature is important if we are to regard the bilingual as a competent but specific speaker-hearer, rather than as the sum of two complete or incomplete monolinguals.

This chapter reports an experiment comparing monolingual English and bilingual English-Italian reactions times for naming pictures with cognate and non-cognate names in English, and another experiment investigating word naming of the same objects. Experiments 11 and 12 employed groups of bilinguals only and investigated whether repetition priming occurs within and across language for these groups of words.

Experiment 9

Bilingual Naming of Cognate and Non-cognate Pictures

In this experiment half the set of experimental items consisted of pictures with cognate names across English and Italian (that is, names that sounded the same in both languages, such as banana - *banana*, anchor - *ancora*) whilst the other half of the set had names which sounded very different across languages (such as apple - *mela*, comb - *pettine*). Of course, since the English group of monolinguals had no knowledge of the Italian language, no difference between cognate and non-cognate picture naming was expected. With the bilingual group, however, we should expect no difference with the cognate pictures if words are represented separately across the two languages, but if words are represented more interactively, the cognate pictures should be named faster.

Method

Participants. A set of 20 English-Italian bilinguals (mean age = 20.3 years, range 18-37) participated in the experiment. All had normal or corrected-to-normal vision and were proficient in both English and Italian. English was the language of the school or work and of the general environment but Italian was the language spoken at home, as all participants were offspring of Italian parents. All the bilinguals took part in some screening tasks before the experiment proper. These consisted of translating passages of text from Italian to English and vice versa, and naming pictures of objects with names of a low frequency.

This group of bilinguals was matched with a control group of 20 native English speakers (mean age = 20.3 years, range 18-37). These participants did not consider themselves to be proficient in any language other than English, and had always lived in England.

Materials. A set of 34 black-and-white pictures of objects comprising of cognate names across English and Italian were chosen from the Snodgrass and Vanderwart (1980) set. The criterion for selection of these was that they were to have in common at least half the number of phonemes of the longer of the two words. Another set of 34 pictures with non-cognate names was selected: these did not share most of their phonemes across the two languages. The two sets of pictures were matched on the variables of: visual complexity, familiarity, frequency, age of acquisition, name agreement, phoneme length and syllable length. For the English stimuli, items were matched on both Celex written and Celex combined frequency, and on both rated and objective age of acquisition. Details of the stimuli are given in Table 5.1 and see Appendix 5 for a full list of items used.

Procedure. Stimuli were presented at random on a Macintosh LCIII computer screen using the Superlab package. Every item was presented for 2500 ms. An asterisk fixation was shown for 1000 ms and offset 50 ms prior to stimulus onset. Reaction times were measured from the onset of the stimulus. Each picture was positioned in the centre of the screen. Subjects wore headphones with a high-sensitivity microphone attached which picked up the subject's initial response, triggering a voice key. There was then an

Table 5.1.

Details of Stimuli used in Experiment 9 - Bilingual Naming of Cognate and Non-Cognate Pictures

	Visual Complexity	Familiarity	Written Frequency	Combined Frequency	Rated AoA	Objective AoA	Name Agreement	Phonemes	Syllables
Italian Cognates									
Min	1.20	1.23	1.00	-	1.43	-	0.65	4.00	1.00
Max.	4.40	4.95	38.50	-	4.14	-	1.00	11.00	5.00
Mean	3.04	2.88	6.02	-	2.64	-	0.95	6.29	2.91
Std. Dev.	1.01	1.36	9.41	-	0.59	-	0.09	1.64	0.93
Italian Non-Cognates									
Min.	1.40	1.32	1.00	-	1.62	-	0.65	2.00	2.00
Max.	4.68	5.00	77.00	-	3.67	-	1.00	11.00	5.00
Mean	3.00	3.25	6.47	-	2.60	-	0.89	6.41	2.97
Std. Dev.	0.93	1.19	14.07	-	0.48	-	0.11	1.73	0.72
English Cognates									
Min.	1.20	1.41	1.00	1.00	1.50	26.50	0.59	2.00	1.00
Max.	4.40	4.41	136.00	132.00	5.90	140.00	1.00	9.00	4.00
Mean	3.04	2.76	19.74	19.03	2.71	55.60	0.93	5.44	2.21
Std. Dev.	1.01	1.00	32.06	31.06	0.83	30.35	0.12	1.76	0.88
English Non-Cognates									
Min.	1.40	1.62	1.00	1.00	1.65	20.50	0.64	2.00	1.00
Max.	4.68	4.90	93.00	89.00	4.65	140.00	1.00	8.00	4.00
Mean	3.02	2.99	19.38	18.44	2.64	52.24	0.93	4.53	1.68
Std. Dev.	0.95	0.85	22.46	21.34	0.73	28.49	0.09	1.50	0.81

interval of 500 ms before the next fixation asterisk appeared, followed 1000 ms later by the next item. Naming latencies were taken as the delay between stimulus onset and registering of the response to the nearest millisecond. The order of presentation of the pictures was randomised by the computer separately for each participant. Participants were requested to name each object *in English* as fast as possible. No Italian was spoken throughout the duration of the experiment. The 68 test items were preceded by 20 practice trials, for which the reaction times were discarded. Naming latencies of each participant for every stimulus were recorded, and the experimenter noted any verbal hesitations or deviations from the target name. These, too were excluded from further analyses.

Results

Any incorrect responses were removed from the analyses. These were responses where the item had been named incorrectly, no responses, or instances where the voice key had failed to trigger. For monolingual participants, of a total of 1360 responses (20 participants x 68 items), 84 responses (6.18%) were removed in total, 38 (2.79%) cognates and 46 (3.38%) non-cognates. Of these 84 incorrect responses, 63 (4.63%) were incorrect responses, 19 (1.40%) were no responses and 2 (0.15%) were due to non-triggering of the voice key.

For the bilinguals, 91 (6.69%) errors were removed. Of these, 31 were cognates (2.28%) and 61 were non-cognates (4.49%). Seventy-three of the 91 incorrect responses (5.37%) were incorrect responses, 15 (1.10%) were no responses and 3 (0.22%) were as a result of the voice key not triggering. Table 5.2 shows the overall mean RTs for the correct responses.

Two-way analyses of variance were carried out on the mean reaction times, and significant effects were found of group - monolinguals were faster than bilinguals at naming the pictures (F1 (1,38) = 34.76, MSE = 89,9940, $p<.001$; F2 (1,66) = 235.99, MSE = 1572725.2, $p=< .001$) and of cognateness; cognates were named faster than non-cognates - this result was only significant by-subjects, however (F1 (1,38) = 11.43, MSE = 6,938, $p = .002$; F2 (1,66) = .48, MSE = 23691.36, $p = .489$). These results were qualified by a significant interaction between group and cognateness (F1 (1,38) = 17.32, MSE = 10,511, $p < .001$; F2 (1,66) = 5.52, MSE = 36795.36, $p = .022$) as shown in Figure 5.1.

When the results were repeated on the harmonic means, only an effect of group was found by-subjects (F1 (1,38) = 29.83, MSE = 664848.11, $p = .002$; F2 (1,66) = 167.74, MSE = 1027818.6, $p = <.001$) with no effect of cognateness (F1 (1,38) = 2.22, MSE = 2343.61, $p = .144$; F2 (1,66) = .22, MSE = 8688.01, $p = .641$) and no significant interaction (F1 (1,38) = 2.31, MSE = 2431.01, $p = .137$; F2 (1,66) = 2.72, MSE = 16654.60, $p = .104$). Analyses of simple main effects showed cognateness to exert a significant effect for the bilinguals (F1 (1,33) = 2.50, MSE = 59768.47, $p = .024$; F2 (1,19) = .87, MSE = 17307.09, $p <.001$) but not for the monolinguals (F1 (1,33) = .02, MSE = 718.25 $p = .879$; F2 (1,19) = .87, MSE = 190.81, $p = .362$).

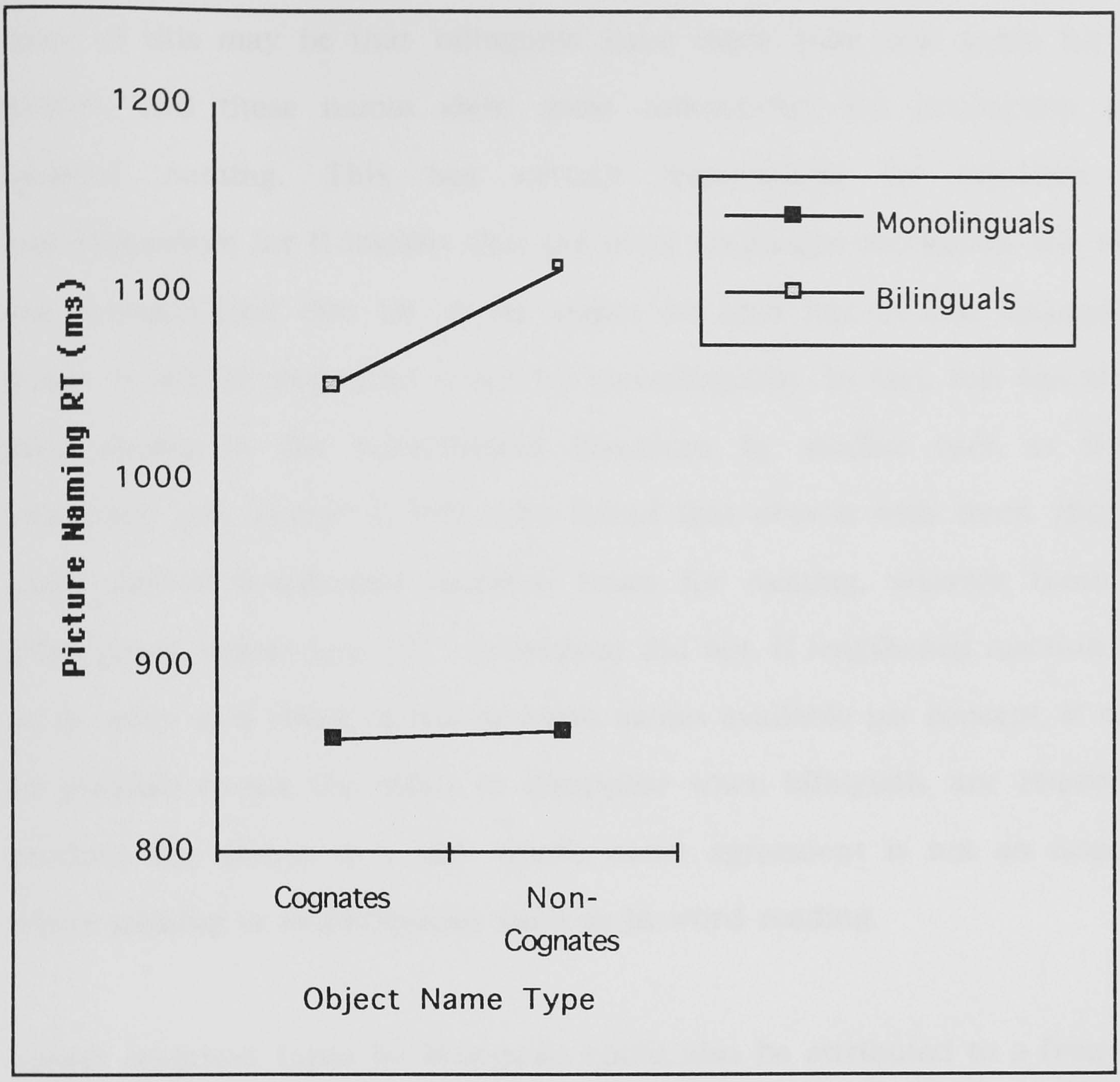
Table 5.2.

Monolingual and Bilingual Mean Reaction Times (ms) and Standard Deviations for Naming Cognate and Non-Cognate Pictures

Participants		Cognates	Non-Cognates
Monolinguals	Mean RT	860	865
	SD	88	80
	% error	5.59	6.76
Bilinguals	Mean RT	1049	1113
	SD	124	153
	% error	4.41	8.97

Figure 5.1.

Monolingual and Bilingual Mean Reaction Times on Naming Cognate and Non-Cognate Pictures



There are two main points of interest to note from the results. Firstly, bilingual participants were significantly slower than monolinguals at picture naming as a whole, taking on average 1083 ms to name the pictures whilst the monolingual group took an average of 868 ms.

Secondly, bilinguals were significantly faster at naming the cognate than the non-cognate pictures - there was an average advantage of 64 ms for cognate pictures. For the monolinguals, on the other hand, there was a difference of only 5 ms between naming cognate and non-cognate pictures.

Discussion

These findings replicate those of Mägiste's in that bilingual participants did show longer reaction times than the monolinguals in picture naming. A cause of this may be that bilinguals have more than one name for each picture, and these names show some competition for production under speeded naming. This has certain implications for research into multilingualism for it implies that the more languages one knows, the slower one becomes and that the more names an item has in one language the slower it will be produced (even by monolinguals). In fact, this has already been shown in the monolingual literature by studies such as that of Vitkovitch and Tyrrell (1995) who found that objects with more than one name showed lengthened reaction times for naming, whereas those with abbreviated names (e.g. *TV* - television) did not. If lengthened reaction times occur soley as a result of having more names available per concept, it should be possible to see the effect to disappear when bilinguals are required to produce the names in a task where name agreement is not an issue and where naming is unambiguous such as in word reading.

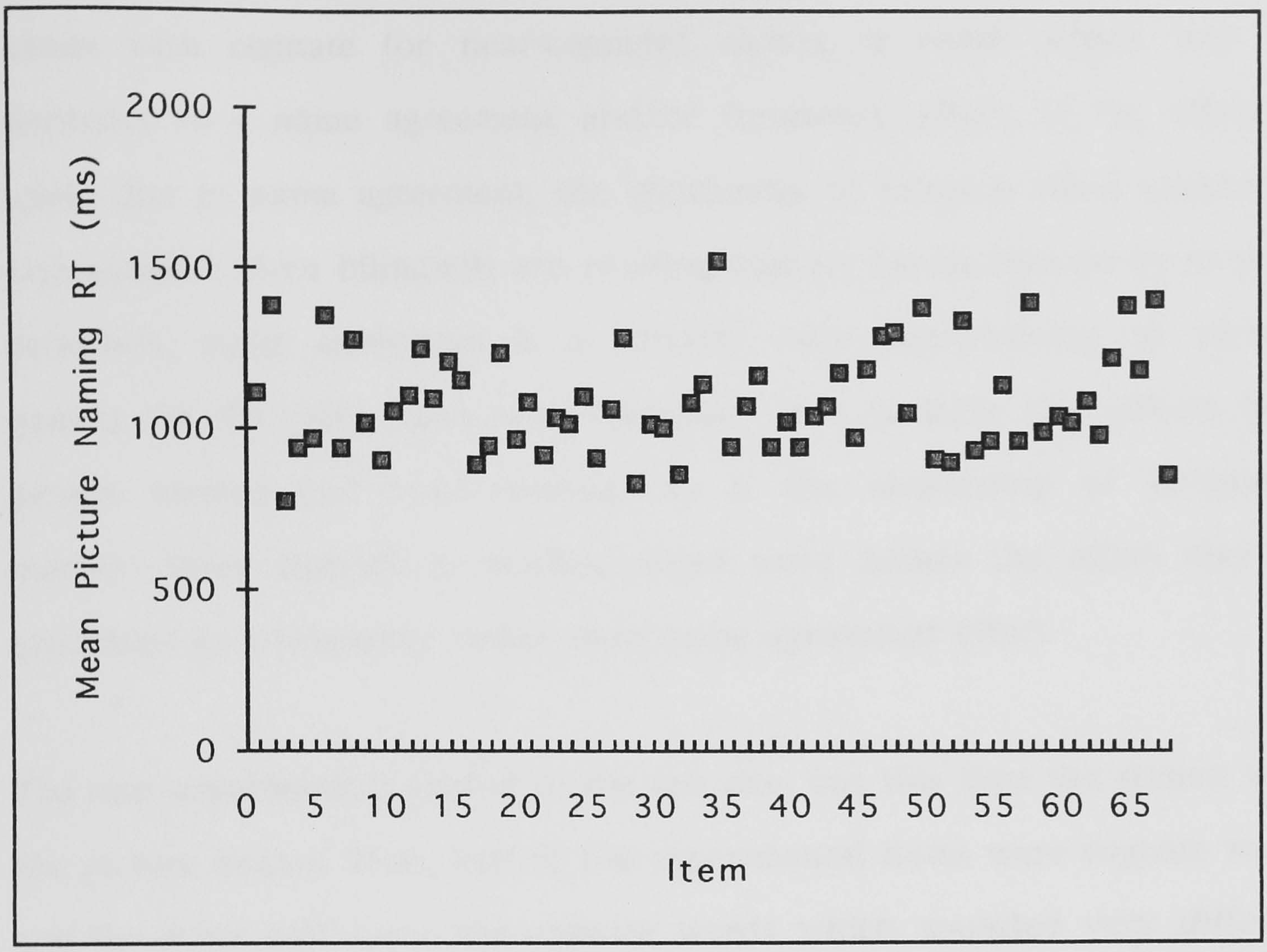
Longer response times by bilinguals could also be attributed to a frequency effect. The logic here is that since 'true' (or compound) bilinguals speak each language half the time, each word is used in each language half as many times as it is by a monolingual speaker. If this is the case, one should still see bilinguals taking longer to respond in word naming even with high frequency words. This frequency explanation also accounts for the fact that bilinguals showed longer reaction times than monolinguals when naming pictures with non-cognate names. The scattergram in Figure 5.2 shows how a few items showed reaction times which were longer than the others. These tended to be non-cognate items of a low name agreement or low familiarity (e.g. spider, eagle, scarecrow). One item in particular that stood out as having a longer mean reaction time and being an outlier was *accordion,* which many participants misnamed 'harmonica' (its Italian name is 'fisarmonica'). The cognate items were chosen on the basis of their similarity in Italian, and the non-cognates were chosen on the basis of their *dissimilarity* to their Italian translation, but the experiment did not control for how similar the cognate object name was to all the other existing words in the Italian language.

On the whole, for bilingual participants the objects with cognate names are the ones which are activated as frequently as they would have been for a monolingual, because in effect they are almost the same word across the two languages, and so activated as often as a monolingual would activate them. This contrasts to non-cognates, which are only activated in either language about half the amount of times as they are for monolinguals. This account assumes that the two lexicons of a bilingual are not separate storages, but that there is a degree of overlap, which increases for cognate than for non-cognate words.

The next experiment examines a fresh set of English-Italian bilinguals reading aloud the written names of the same objects. Word reading is a relatively unambiguous task yielding low error rates, so if bilinguals' lengthened reaction times in picture naming are due to name agreement effect then bilinguals and monolinguals should respond at the same rate.

Figure 5.2.

Scattergram Showing Relationship between Mean Reaction Times and Items for the Bilingual Participants



Instead, if the longer reaction times are due to a frequency effect (that is, that English-Italian bilinguals use each English word half the time as an English speaker) participants should respond slower to the non-cognate words. Assuming that a bilingual's lexicon does not operate as two separate stores, we can expect that the bilinguals will still read cognate words faster than non-cognate words since these are read aloud with almost the same frequency as a monolingual would read them.

Experiment 10

Bilingual Reading of Cognate and Non-cognate Picture Names

Bilingual picture naming showed shorter reaction times for the picture names with cognate (or near-cognate) names, a result which may be attributed to a name agreement and/or frequency effect. If the effect is solely due to name agreement, the shortening of reaction times should be extinguished when bilinguals are *reading* cognate names because by its very definition, name agreement is a variable only appertaining to picture naming. On the other hand, word frequency is a variable that affects both picture naming and word reading, so if the shortening of bilinguals' reaction times extends to reading aloud word names the effect may be attributed to a frequency rather than name agreement effect.

The next experiment is similar to the last one, but this time the stimuli were the picture *names*. Thus, half of the experimental items were cognate words and the other half were non-cognate words which sounded very different across English and Italian. A fresh group of English-Italian bilinguals (of the same mean age and proficiency as the last group) was employed, matched by a new group of English monolingual participants. The group of English monolinguals had no knowledge of Italian, and so no difference should be found between cognate and non-cognate word reading for these items.

If the difference between cognate and non-cognate picture naming occurs solely as a result of a name agreement effect for the bilinguals, no difference in word reading should be expected. If there are additional effects of frequency, the bilingual participants should still display a difference between reading cognate and non-cognate word names. Moreover, an absence of a difference between the bilinguals' reading cognate and non-cognate words aloud could also indicate that there are independent lexical representations - even for cognate words - across the two languages.

Method

Participants. A fresh set of 20 English-Italian bilinguals (mean age = 20.3 years, 16-34) participated in the experiment. All had normal or corrected-to-normal vision and were proficient in both English and Italian, with English being the language of the general environment and Italian being the language spoken at home. Again, all bilinguals took part in the same screening tasks as before, prior to commencing the experiment proper.

Again, the bilingual group was matched with a control group of 20 native English speakers (mean age = 20.6 years, range 16-34) who did not consider themselves to be proficient in any language other than English, and had always resided in England.

Materials. The stimulus materials were the English picture names for the set of 68 black-and-white object pictures used in Experiment 10. Half of the set were object names which were cognates or near-cognates across English and Italian (they had in common at least half the number of phonemes of the longer of the two words), whilst the other half were non-cognate words and did not share their phonemes across the two languages.

Procedure. Again, the procedure was identical to that of the last experiment. Stimuli were presented at random on the same computer screen, for the same amount of time using the Superlab package. This time the stimuli were the picture *names*. Each word was positioned in the centre of the screen for 2500 ms and presented in black, lower case using a 48-point Geneva font. Participants wore headphones which had a high-sensitivity microphone attached, picking up the subject's initial response which triggered a voice key. After an interval of 500 ms, the next fixation asterisk appeared and was followed 1000 ms later by the next item. Reaction times were measured from the onset of the stimulus. Words were presented in a randomised order and preceeded by 20 practice trials for which reaction times were discarded. Participants were required to read each word aloud *in English* as fast as possible, without hesitation. Again, no Italian was spoken throughout the duration of the experiment. Naming latencies of each participant for every stimulus were recorded, as were any verbal hesitations or deviations from the target word. These were very few, and were excluded from the analyses.

Results

Incorrect responses were removed from the analyses which, for word naming were very few, consisting solely of six no responses and instances voice key non-triggerings or misfirings. For monolingual participants, of 1360 responses only 2 (0.15%) were removed, both of which were voice-key misfirings. In the bilingual set, there were five (0.37%) incorrect responses.

Two-way analyses of variance were carried out on the average reaction times. Significant effects were found of group - monolinguals were faster than bilinguals at reading the words (F1 (1,38) = 8.71, MSE = 222710.51, $p <$ .005; F2 (1,66) = 206.42, MSE = 378745.07, $p < .001$), and of cognateness by-subjects, but not by-items (F1 (1,38) = 4.26, MSE = 1911.01, $p = .046$; F2 (1,66) = .70, MSE = 3271.24, $p = .407$) and an interaction which was also lost in the by-items analysis (F1 (1,38) = 6.29, MSE = 2820.31, $p = .016$; F2 (1,66) = 2.62, MSE = 4812.36, $p = .110$). This is shown in the graph in Figure 5.3. On average the monolingual participants responded faster than bilingual ones (561 vs. 667 ms). There was a difference of only 2 ms between reading of cognate and non-cognate words for the monolingual participants, with non-cognates read aloud faster than cognates, but for the bilinguals the difference was slightly bigger at 21 ms, and in the other direction.

The results were highly consistent when repeated with harmonic means. Effects were found of group (F1 (1,38) = 7.49, MSE = 165347.11, p < .001; F2 (1,66) = 112.21, MSE = 169835.56, p <.001), with cognateness missing significance (F1 (1,38) = 3.73, MSE = 1629.01, p = .061; F2 (1,66) = .91, MSE = 3541.44, p = .343) and a significant interaction between the two by-subjects only (F1 (1,38) = 6.08, MSE = 2656.51, p = .018; F2 (1,66) = 3.11, MSE = 4705.88, p = .082). Analyses of simple main effects showed a significant impact of language on cognateness for bilinguals only (F1 (1,33) = 85.94, MSE = 234471.31, p <.001; F2 (1,19) = 8.13, MSE = 4671.81, p = .010) and for cognateness within language for both groups by items only (F1 (1,33) = .11, MSE = 74.13, p = .739; F2 (1,19) = 10.80, MSE = 132977.69, p = .004 for the monolinguals and F1 (1,33) = 1.44, MSE = 8009.47, p = .239; F2 (1,19) = 8.48, MSE = 91774.22, p = .009 for bilinguals).

Table 5.3.

Monolingual and Bilingual Mean Reaction Times (ms) and Standard Deviations for Naming Cognate and Non-Cognate Pictures

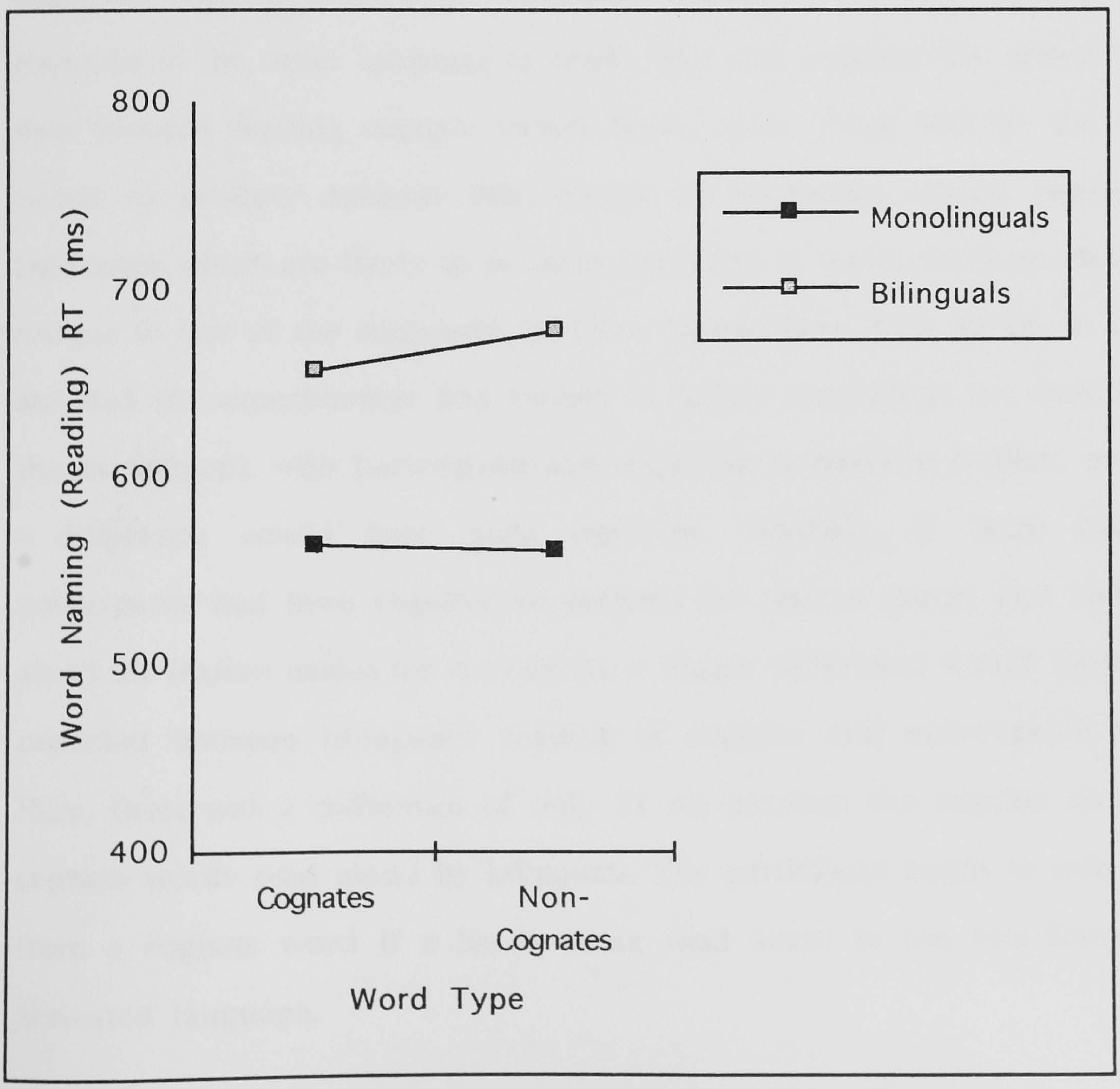
Participants		Cognates	Non-Cognates
Monolinguals	Mean RT	562	560
	SD	25	29
	% error	0.29	0
Bilinguals	Mean RT	656	677
	SD	58	91
	% error	0.74	0

Discussion

As with the picture naming version of this experiment, bilingual participants read English words aloud slower than did monolingual participants. The two groups were matched for level of education, so the difference was not due to bilinguals reading less or slower on the whole. The overall difference could have been attributed to bilinguals reading aloud in English less frequently than monolingual particpants, given that they should be spending half the time operating in their other language.

Figure 5.3.

Monolingual and Bilingual Mean Reaction Times for Reading Aloud Cognate and Non-Cognate Words



However, as all the participants were young adults living in the UK most of the time and working in the UK all of the time, it is unlikely that these bilingual participants read very much Italian. Most usage of the Italian language for these participants occurs in the spoken modality or as a result of listening to the language. This is not to say that the bilinguals read *no* Italian, rather, that they were immersed in an environment where there was more exposure to the written forms of one language than the other, even in mundane and everyday life situations such as on billboards and street signs.

A more likely explanation is that the lengthening of reaction times is due to participants' inhibition of the language they were not using at the time - in this case, Italian. Since for these participants, English is the most frequently used and thus the most highly activated language, the amount of inhibition required of the other language is small. This also explains the (albeit small) bias towards reading cognate words faster, since these will be the easier words to produce because they consist of phonemes shared across two languages which are likely to be more practiced in comparison to phonemes unique to one of the languages. Had the instructions been given in Italian and had the experimenter had spoken in Italian throughout the duration of the experiment, with participants still requiring to name in English, more of a difference would have been expected. Similarly, if these bilingual participants had been required to perform the task in Italian and had read aloud the *Italian* names for the objects, a bigger difference would have been expected between bilinguals' reading of cognate and non-cognate words. Here, there was a difference of only 21 ms between the cognate and non-cognate words read aloud by bilinguals. The participant ought to gain more from a cognate word if a list is being read aloud in the less frequently activated language.

In terms of shared and separate stores, these results indicate some shared storage. If the two sets of words, English and Italian, were in separate stores bilingual participants would have simply switched off their Italian store and activated their English store for both this word reading experiment and the previous picture naming one. Instead, longer reaction times were found for both, but especially in picture naming, which suggests that there was also an influence from bilinguals having more than one name for each object. The results hint at a replication of findings by Grainger and Dijkstra (1992), who believe that words in the two languages of a bilingual may be activated simultaneously, at least in the initial phase of word recognition. These authors found that French-English bilinguals carrying out a monolingual lexical decision task in English reacted more slowly to English words that had more French than English neighbours - that is, to words which were more orthographically simliar to the stimulus. If their participants had only been operating in English and had completely switched off their French, this result would not have occurred.

These results may be related to Experiments 2 and 4, where picture and word naming by native speakers of Italian were examined. The Italian participants in those experiments showed longer mean reaction times (1035 ms for picture naming and 583 ms for word naming), compared to Experiments 1 and 3 where the English participants showed mean RT's of 935 ms for picture naming and 527 ms for word naming. In Experiments 9 and 10, the monolingual (i.e. English native) participants were faster again, showing a mean RT of 868 ms for picture naming and 561 ms for word naming. Bilingual participants were found to be slower, both than the native English participants but also than the native Italian participants, with a mean RT of 1083 ms for picture naming and 667 ms for word naming. Hence, the longer reaction times observed for Italian participants in Experiments 2 and 4 may not be occurring as a result of the characteristics of Italian words, because the bilingual participants also showed lengthened RTs and they were naming in English. Part of the reason for lengthed RTs in Italian participants were due to intrinsic difference in Italian naming (for example, an increased retrieval of grammatical information) compared to English naming. Furthermore, these reaction times indicate that bilingual participants were not simply taking longer to name because they had knowledge of Italian words, since their average RTs were also slower than the RTs for native Italian participants.

To summarise, there are three plausible reasons why bilinguals showed longer reaction times than monolinguals in picture and word naming, and why bilinguals showed a bigger advantage in naming cognate over non-cognate words for picture than for word naming. First, is the notion of competing systems. The participants were naming in their stronger language and in the language that they were more exposed to. Had the same participants been in a discordant situation, naming in Italian for example, or had Italian-English participants in Italy but naming in English been employed, more inhibition of the other language would have been found. Although a bilingual speaker must effectively turn off or inhibit one language to operate successfully in the other, if that language is the easier of the two to switch off, less inhibition is required (or less competition occurs).

Secondly, in picture naming the bilingual participants had more than one name for the item they were being required to name under speeded conditions. When compared to the word reading version of the same experiment where participants were simply required to produce the word presented, it becomes apparent as to why there less inhibition would have occurred for the latter task, hence the reason for less of a difference occurring between cognate and non-cognate words for this task.

Thirdly, the reason why bilingual participants showed an advantage for naming cognate over non-cognate words as picture names but not written words may be explained in terms of frequency of usage. By definition, bilingual English-Italians will use English half the time and Italian for the half. However, this does not specifiy *which modality* the two languages will be used. In terms of speaking, these bilingual participants probably do spend almost half their time speaking Italian with it being the language of the home. So for picture naming, there will be a disadvantage for them when they are asked to ignore one language and use the other. In terms of reading, however, Italian is read less frequently than it is spoken so ignoring the language in the written modality is not as arduous a task. This, coupled with the lack of competing names results in a small difference between reading aloud cognate and non-cognate words.

The fact that cognates show any difference at all for bilingual speakers is evidence that this class of words is, indeed, the key to distinguishing between separate and shared storages of the bilingual lexicon. These two experiments have shown that some interaction exists between the two lexicons. The next two experiments investigate this in more detail.

5.2 Repetition Priming of Cognate and Non-Cognate Pictures

The validity of the various configurations of the bilingual lexicon may be tested using the technique of repetition priming, whereby a single encounter with a familiar word, face or object facilitates the later naming of the same word, face or object some time later. The technique has already been used to explore the processes underlying familiar face (Ellis, Flude, Young & Burton, 1996) and object recognition (Wheeldon & Monsell, 1992). The approach is based on the hypothesis that repetition strengthens the connections between different representations inolved in recognising and/or producing a familiar item, thus producing facilitation. It is important to distinguish repetition priming from the technique of semantic (or associative) priming, which is where recognition of one familiar word, face or object primes the recognition of related items. For example, recognition of the word *nurse* facilitates recognition of associated words such as *doctor* or *hospital*. There are at least two differences between repetition and semantic priming. Firstly, repetition priming is long lived, it can survive the interposition of other stimuli, whereas putting other stimuli in between, say *doctor* and *nurse* eliminates semantic priming. Secondly, semantic priming can cross domains, so recognition of a word can prime recognition of a picture of a related object. With repetition priming, however, the effect is domain-specific in the long-term, so pictures prime pictures and words prime words only; but in the short-term, repetition priming can also cross domains as a result of temporary strengthening of permanent semantic memory codes. If prime and target from different modalities are presented on adjacent trials, some 'self' or 'identity' priming occurs, which shows the same dissipation over trials as with semantic priming. Semantic priming from one word to another has been shown to be almost as effective across as within languages (de Groot, 1992) - so both *nurse* and *infermiera* should equally prime the production of *doctor*. This has been taken as evidence in support of a common set of conceptual-semantic representations across the two languages of a bilingual.

Two experiments involving repetition priming were run with fresh sets of 24 compound bilingual participants in each. The first experiment examines the amounts of repetition priming when participants are naming in English in Phase 2 (or on the second occasion) and the second experiment looks at amounts of priming when a new group of bilinguals named pictures in Italian in Phase 2. Each bilingual received one set of pictures to name in English, one to name in Italian and one set went unseen (this is the unprimed set). Hence, participants saw one set of pictures to name in the *same* language as Phase 1, one set of pictures to name in the *other* language as Phase 1 and one set went unprimed. In addition to this, half the items of each set were pictures with cognate names and the other half were pictures with non-cognate names. For Experiment 11, in Phase 2 all pictures were named in English. For Experiment 12, in Phase 2 all pictures were named in Italian.

If the bilingual lexicon consists of representations which are *shared* across two languages (and if the elements that are shared are the cognate words) we should find evidence of cross-language facilitation for naming cognate pictures, but less for naming the non-cognate pictures. If the representations are held in separate stores which do not interact or compete, we should see identical reaction times for cognate and non-cognate words and little or no amounts of repetition priming. Where the participant is naming a picture in the same language twice, though, (that is, for the *same* language condition) we should see standard amounts of repetition priming.

Experiment 11

Repetition Priming of Cognate and Non-Cognate Pictures in English

Method

Participants. A new set of 24 English-Italian bilinguals (mean age = 22.4 years, range 19 - 36) participated in the experiment, all of which were proficient in both English and Italian. As before, the participants came from Italian immigrant families and used Italian in the home and English at work or school. All had normal or corrected-to-normal vision. Again, all bilinguals took part in the same screening tasks as before, prior to commencing the experiment proper. Screening tasks given before the experiment proper, and consisting of translating passages of text from Italian to English and vice versa, and naming pictures of objects with names of a low frequency, confirmed that these participants were balanced bilinguals and highly proficient in both languages.

Materials. Three sets of 28 Snodgrass and Vanderwart (1980) and new York (1997) pictures were selected. Fourteen of these in each set were pictures which have names that are near-cognates across English and Italian - i.e., names which share around 70% of phonemes (e.g., *telephone* - *telefono*). The other fourteen pictures in each set were pictures with names which are non-cognates and very dissimilar across the two languages (e.g., *bell* - *campana*). The six sets (sets 1-3, cognates and non-cognates) were matched on the variables of: visual complexity, familiarity, frequency, age of acquisition, name agreement, phoneme and syllable length. Language-specific measures were used, so for Italian familiarity, for example, ratings had been obtained from Italian participants.

Procedure. All of the black-and-white picture stimuli were presented on a Macintosh LCIII computer screen using the Superlab package. In Phase 1, participants were required to name one set of pictures in English and one set in Italian (one set went unseen and thus unprimed). The order of the sets was counterbalanced using Greco-Latin square, as was the order of language presentation - half the participants received an Italian before an English set, and the other half received an English before an Italian set. There was a short break of about five minutes between sets.

Participants were spoken to in English when in the English naming condition and in Italian when in the Italian naming condition, and instructed in the appropriate language. The pictures were randomised within their respective sets, and contained 20 practice items per set, the reaction times to these were discarded.

In Phase 2, participants received all 84 pictures - one set of which they had just seen in English (the *same language* condition), one set they had just seen in Italian (the *other language* condition), and one set they had not yet seen (this was the *unprimed* condition). The pictures were randomised and presented with 20 practice items.

For both phases of the experiment, each picture was presented for 2500 ms with an asterisk fixation dot for 1000 ms which was offset 50 ms prior to stimulus onset. Reaction times were measured from the stimulus onset. Each picture was positioned in the centre of the screen. Participants' initial responses triggered a voice key, and were recorded by a high-sensitivity microphone which was attached to headphones which they wore. There followed an interval of 500 ms before the next fixation asterisk appeared, followed by the next item. Naming latencies were taken as the delay between stimulus onset and registering of the response to the nearest millisecond. The order of presentation of the pictures was randomised by the computer separately for each participant. In each condition, participants were requested to name each picture as fast as possible, without hesitation, and the experimenter noted any deviations from the target.

Results

Any incorrect responses were removed from the analyses. There were 2016 responses in all (84 responses x 24 participants). Of these responses, 72 (3.57%) were removed as they were errors. Twenty (27.78%) of these were to cognate items and 52 (72.22%) were to non-cognate items. Another way to look at these errors is in terms of priming condition. Twenty-two (30.56%) errors occurred in the same language condition, 22 (30.56%) in the other language condition, and 28 (38.89%) errors occurred for unprimed items.

There are several points to note, as shown by Table 5.4 and Figure 5.4. First of all, the bilinguals named the pictures with cognate names faster than those with non-cognate names overall (898 ms vs 978 ms). Surprisingly, this distinction between cognates and non-cognates was even present for the unprimed words, replicating the results of Experiment 9. Secondly, the bilinguals were fastest to name the pictures when they had been previously named in English in Phase 1 (in the same language condition), slower when they had been named in Italian in Phase 1 (the other language condition) and slowest of all in the unprimed condition. The mean reaction times for these conditions were 876, 906 and 1033 ms respectively. There was much to be gained from having already accessed a representation in the same language, but less to be gained from having accessed it in the second language.

Clearly, the most facilitation occurred when participants named the pictures in the same language twice and the least facilitation occurred in the condition where participants had not seen the pictures before. Some facilitation occurred from having seen the pictures to name once in the other language which could be due to having accessed links between visual and semantic representations on both occcasions. If this is the case, we should also expect to see *some* facilitation if the experiment were repeated in the opposite direction, that is, having seen the pictures to name in English first and Italian on the second occasion.

Three-way analyses of variance conducted on the 24 subjects' responses as arithmetical means with the between-groups factor of set revealed no effect the factor of set ($F1\ (5,18) = .67$, $MSE = 76457.69$, $p = .649$) which was expected given that these were three matched sets. Significant effects were found of both priming ($F1\ (2,36) = 71.76$, $MSE = 334414.53$, $p < .001$) and of cognate condition ($F1\ (1,18) = 77.41$, $MSE = 229201.56$, $p < .001$). The only interaction was between group and priming condition ($F1\ (10,36) = 2.46$, $MSE = 11446.51$, $p = .024$). One set yielded higher error rates than the others. It contained one problematic item with a consistently high error rate - *accordion*, Its Italian name *fisarmonica* is a near-cognate to the English word *harmonica*.

Two-way ANOVAs were conducted employing the two within-group factors of priming condition (same, other or unprimed condition) and cognateness (cognate or non-cognate names). Strong effects were found of priming condition ($F1\ (2,46) = 11.57$, $MSE = 227538.69$, $p < .001$; $F2\ (2,164) = 49.59$, $MSE = 686702.34$, $p < .001$) and cognate condition ($F1\ (1,23) = 71.52$, $MSE = 149962.56$, $p < .001$; $F2\ (1,82) = 7.64$, $MSE = 392077.78$, $p = .007$) but no interaction ($F1\ (2,46) = 2.38$, $MSE = 2629.08$, $p = .103$; $F2\ (2,164) = .33$, $MSE = 4586.36$, $p = .719$). The results were the same with harmonic means - strong effects were found of priming condition ($F1\ (2,46) = 15.66$, $MSE = 334290.53$, $p < .001$; $F2\ (2,164) = 55.17$, $MSE = 482329.36$, $p < .001$) and cognate condition ($F1\ (1,23) = 82.54$, $MSE = 229361.17$, $p < .001$; $F2\ (1,82) = 9.12$, $MSE = 365866.68$, $p = .003$) and no interaction ($F1\ (2,46) = .09$, $MSE = 148.36$, $p = .916$; $F2\ (2,164) = .86$, $MSE = 7497.93$, $p = .426$).

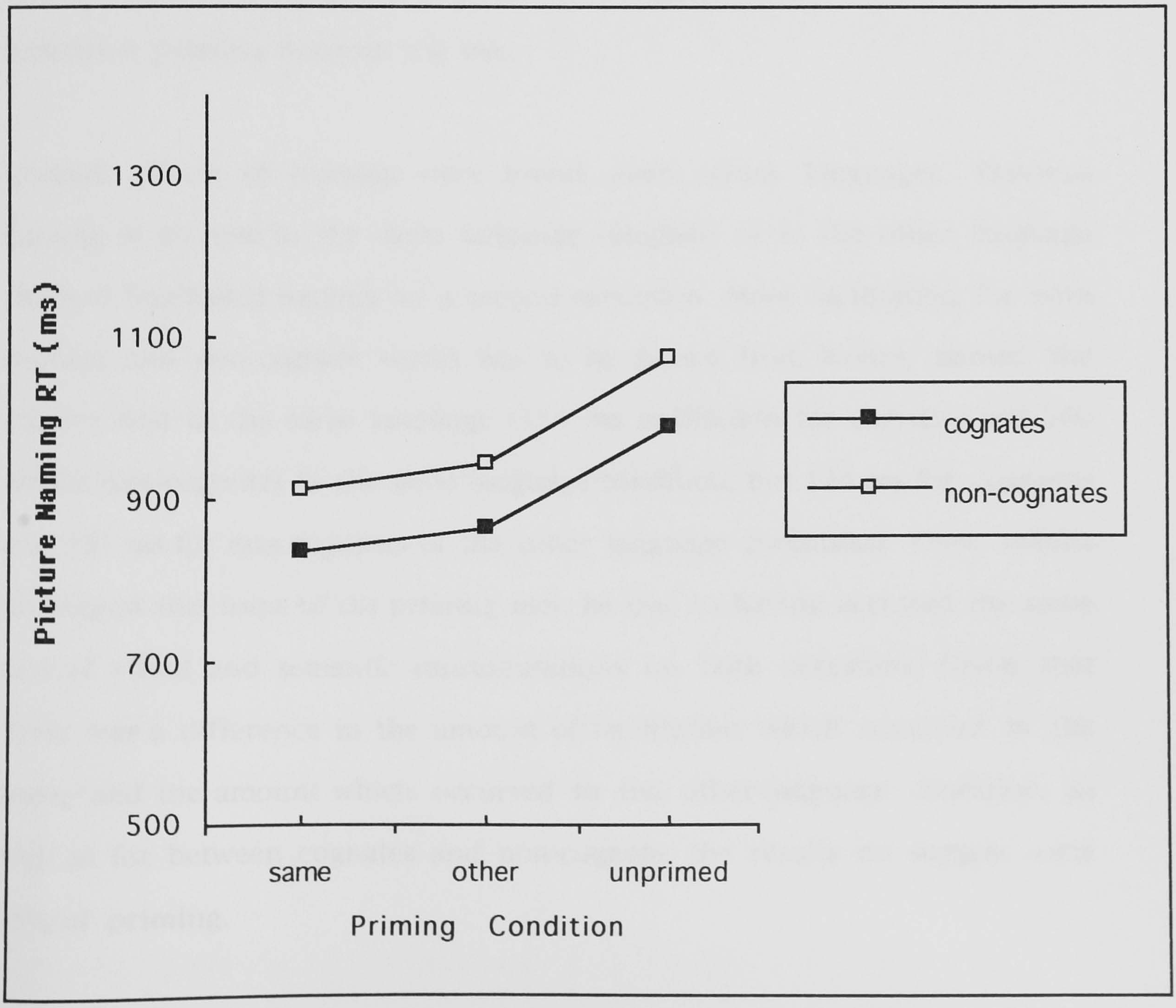
Table 5.4

Bilingual Mean Reaction Times (ms) for Priming of Cognate and Non-Cognate Pictures in English Phase 2

	PRIMING CONDITION					
	same language (English)		other language (Italian)		unprimed	
	cognates	non-cognates	cognates	non-cognates	cognates	non-cognates
mean RT (ms)	837	915	867	944	991	1075

<u>Figure 5.4.</u>

Bilingual Mean Reaction Times (ms) for Priming of Cognate and Non-Cognate Pictures in English Phase 2



Discussion

Preliminary analyses revealed no effect of set or order, which was expected given that the sets were matched and order was counterbalanced. Effects of cognateness were found, with cognate objects being named faster than those with non-cognate names (an average of 898 ms for cognate and 978 ms for non-cognate names). Of particular interest is the fact that this difference between cognate and non-cognate words even extends to the unprimed items. That is, items that participants had not seen beforehand which replicates the results of Experiment 9. These findings suggest that the representations for names are *not* held in non-interacting stores and with complete independence, for if this were the case there would have been near identical reaction times for cognate and for non-cognate items with little or no repetition priming between the two.

Instead, effects of priming were found, even across languages. Previous naming of an item in the same language (English) or in the other language (Italian) facilitated naming on a second occcasion. More facilitation for both cognate and non-cognate words was to be gained from having named the picture first in the same language (154 ms facilitation for cognates and 160 ms for non-cognates in the same language condition, but 124 ms for cognates and 131 ms for non-cognates in the other language condition). These results do suggest that some of the priming may be due to having accessed the same sets of visual and semantic representations on both occasions. Given that there was a difference in the amount of facilitation which occurred in the same- and the amount which occurred in the other-language condition, as well as for between cognates and non-cognate, the results do suggest some lexical priming.

There is a lot to be gained from running the experiment in the converse, with a matched set of bilingual participants repeating the procedure but with Italian as the given language. Firstly, it should still be possible to see effects of cognateness with cognates being named faster. Given that Italian is the least used language of these bilinguals (but in many cases the first acquired) this time more facilitation should be gained from the cognates because naming will occur in the 'weaker' language. Secondly, one should expect to obtain effects of priming if language stores for English and Italian do interact, and more facilitation in the 'other' condition if priming is as a linguistic result rather than as a result of having seen and accessed the semantics for an item on two occasions.

Experiment 12

Repetition Priming of Cognate and Non-Cognate Pictures in Italian

Experiment 11 required the pictures to be named in English in Phase 2. For this experiment, they are named by a fresh set of bilinguals in Italian. Participants are matched to participants in the previous experiment on bilingualism (they are screened for proficiency in both languages beforehand), age and sex. Again, the orders of the sets are counterbalanced.

Method

Participants. Different bilinguals were used. Twenty-four compound English-Italian bilinguals (mean age = 2.6 years, range 19 - 36) who had undergone initial screening for proficiency in both languages, and who had normal or corrected-to-normal vision took part.

Stimulus materials. The same sets of 28 Snodgrass & Vanderwart (1980) pictures and new York (1997) pictures, half with cognate and half with non-cognate picture names were used as before.

Procedure. Again, the pictures were presented on the same Macintosh LCIII computer screen using the Superlab package. As before, Phase 1 required participants to name one set of pictures in Italian and one set in English and one set went unseen (this was the unprimed set). Set order and order of language presentation were counterbalanced. Once more, a short break of about five minutes incurred between sets, and participants were instructed in the language of the naming condition. Pictures were randomised within their respective sets, with 20 practice items per set, the reaction times of which were discarded.

Phase 2 required the participants to name all 84 pictures in Italian. To re-cap, one set of these had been already named in Italian (the *same language* condition), one set had already been named in English (the *other language* condition), and one set had not yet been seen (the *unprimed* condition). The full set of pictures was randomised and presented with 20 practice items.

The procedure was identical to that of the previous experiment, that is, in both phases each picture was presented for 2500 ms. There was an asterisk fixation dot for 1000 ms, this was offset 50 ms prior to stimulus onset, and reaction times were measured from the stimulus onset. Each picture was positioned in the centre of the screen. A voice key was triggered by the participant's initial response which was recorded by a high-sensitivity microphone attached to a headphone set. Reaction times were taken as the delay between stimulus onset and registering of the response to the nearest millisecond. Picture order was randomised by the computer for each participant, who was asked to produce a name for each picture as fast as possible and without hesitation. Any deviations from the target were noted by the experimenter.

Results

Again, incorrect responses were removed from the analyses. As with the previous experiment, there were of 2016 responses in all (84 responses x 24 participants). There were considerably more errors for this Italian version of the experiment. Of the 2016 responses, 259 (12.85%) were incorrect and removed. Seventy-four (28.57%) of these were to cognate items and 185 (71.43%) were to non-cognate items. In terms of priming condition, 73 (28.19%) errors occurred in the same language condition, 82 (31.66%) in the other language condition, and 104 (40.15%) errors occurred for unprimed items.

The first point to note is that the error rate for this experiment is considerably higher than for the last experiment where picture naming occurred in English. There were substantially more errors occuring for non-cognate than for cognate names items. Also, more errors occurred for other language- than for same language-primed items but the most errors for both experiments occurred in the unprimed condition. This last difference is expected given that seeing the item prior to speeded naming is beneficial. The fact that more errors are made in the other language than in the same language condition, however, suggests that some *competition* may be occurring between the two languages. Also, overall the bilinguals took longer to respond in this experiment than in the last one (mean response time here was 1118 ms, for the naming in English in the last experiment it was 938 ms). This could reflect the fact that these bilinguals used English more than they used Italian and were in an English environment.

Again, as shown in Table 5.5 and Figure 5.5, bilinguals named the pictures with cognate names faster than those with non-cognate names overall (1070 ms vs 1166 ms). In this experiment, too, the distinction between cognates and non-cognates was even present for the unprimed words, but the difference between the two word types was greater (a facilitation of 165 ms between cognates and non-cognates) than in the last one where unprimed naming occurred in English (a difference of 74 ms). For bilinguals naming in Italian (their less dominant language) it appears that the difference between naming a cognate and non-cognate picture is greater than for naming in English (96ms vs 80 ms).

As before, naming in the same language condition was fastest (1009 ms) follwed by naming in the other language condition (1100 ms) and naming in the unprimed condition was slowest (1246 ms). The most facilitation was to be gained from having named the picture before in the same language and the least was to be gained from having not seen it at all - although there was still a difference between cognate and non-cognate pictures in the unprimed condition, hinting at an ease of access of represention for cognate words.

The presence of small amounts of cross-linguistic priming (88 ms for cognates and 203 ms for non-cognates) could, once more, be partly due to having seen the same picture twice, and thus having accessed the links between visual and semantic representations on two occcasions. However, given that there is a difference between cognates and non-cognates, it is unlikely that facilitation only occurred for this reason.

ANOVAs were performed on the 24 subjects' mean reaction times, and strong effects were found of both priming condition ($F1\ (2,46) = 11.84$, $MSE = 720731.52$ $p < .001$; $F2\ (2,164) = 54.48$, $MSE = 1129365.6$, $p < .001$) and cognate condition (F1 (1,23) = 84.27, MSE = 744337.56 $p < .001$; F2 (1,82) = 6.43, MSE = 766265.14, $p = .013$), with an interaction between the two that was only significant by-subjects (F1 (2,46) = 4.87, MSE = 29114.31, $p = .012$; F2 (2,164) = 1.35, MSE = 28021.65, $p = .262$). The results were identical when harmonic means were employed - strong effects were found of priming condition (F1 (2,46) = 11.89, MSE = 512312.84, $p < .001$; F2 (2,164) = 55.42, MSE = 918710.59, $p < .001$) and cognate condition (F1 (1,23) = 55.06, MSE = 552420.56, $p < .001$; F2 (1,82) = 6.19, MSE = 585225.14, $p = .015$) and an interaction between the two that was only significant by-subjects (F1 (2,46) = 6.04 , MSE = 38410.19, $p = .005$; F2 (2,164) = 2.25, MSE = 37222.05, $p = .109$).

Table 5.5

Bilingual Mean Cognate Priming Mean Reaction Times (ms) in Italian Phase 2

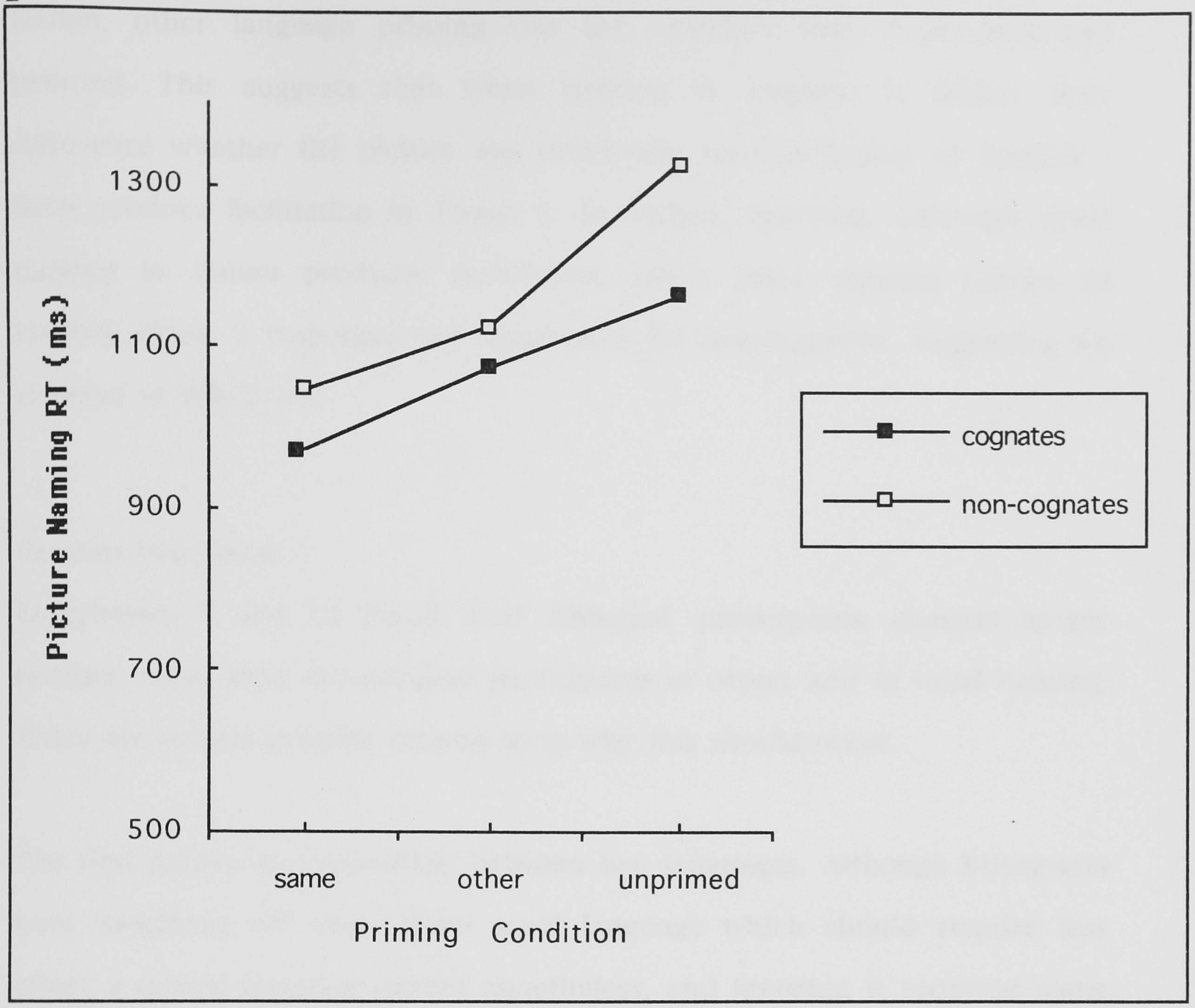
	PRIMING CONDITION					
	same language (Italian)		other language (English)		unprimed	
	cognates	non-cognates	cognates	non-cognates	cognates	non-cognates
mean RT (ms)	972	1045	1075	1125	1163	1328

Merged Data

The English and the Italian data were merged as in Figure 5.6 and analyses of variance were performed. There were three factors: language (English or Italian), priming condition (same language, other language, unprimed) and cognateness (cognate or non-cognate). Significant effects of language were found; with Italian RTs being significantly slower than the English RTs (1135 ms for Italian and 938 ms for the English RTs). There were also significant effects of priming condition. Overall, RTs were longest for the unprimed condition (1140 ms) followed by the other language priming condition (1028

Figure 5.5.

Bilingual Mean Cognate Priming Mean Reaction Times (ms) in Italian Phase 2



ms) and shortest for the same language priming condition (942 ms). There was a main effect of cognateness, with faster RTs shown for cognate than for non-cognate words (984 ms for cognate and 1089 ms for non-cognate words).

There were significant first order interactions between language and priming condition, language and cognateness, and cognateness and priming condition. These were qualified by a second order interaction between language, priming condition and cognateness. The first order interactions are subsumed within the second order interaction. The separate analyses of

Experiments 11 and 12 indicate that this arises because in English, other language priming was almost as good as same language priming. However, in Italian, other language priming was less effective than same language priming. This suggests that when naming in English, it makes little difference whether the picture was previously seen in Italian or English - both produce facilitation in Phase 2. In Italian, however, although prior naming in Italian produces facilitation, when prior naming occurs in English, Phase 2 responses are lengthened for non-cognates, suggesting an element of inhibition.

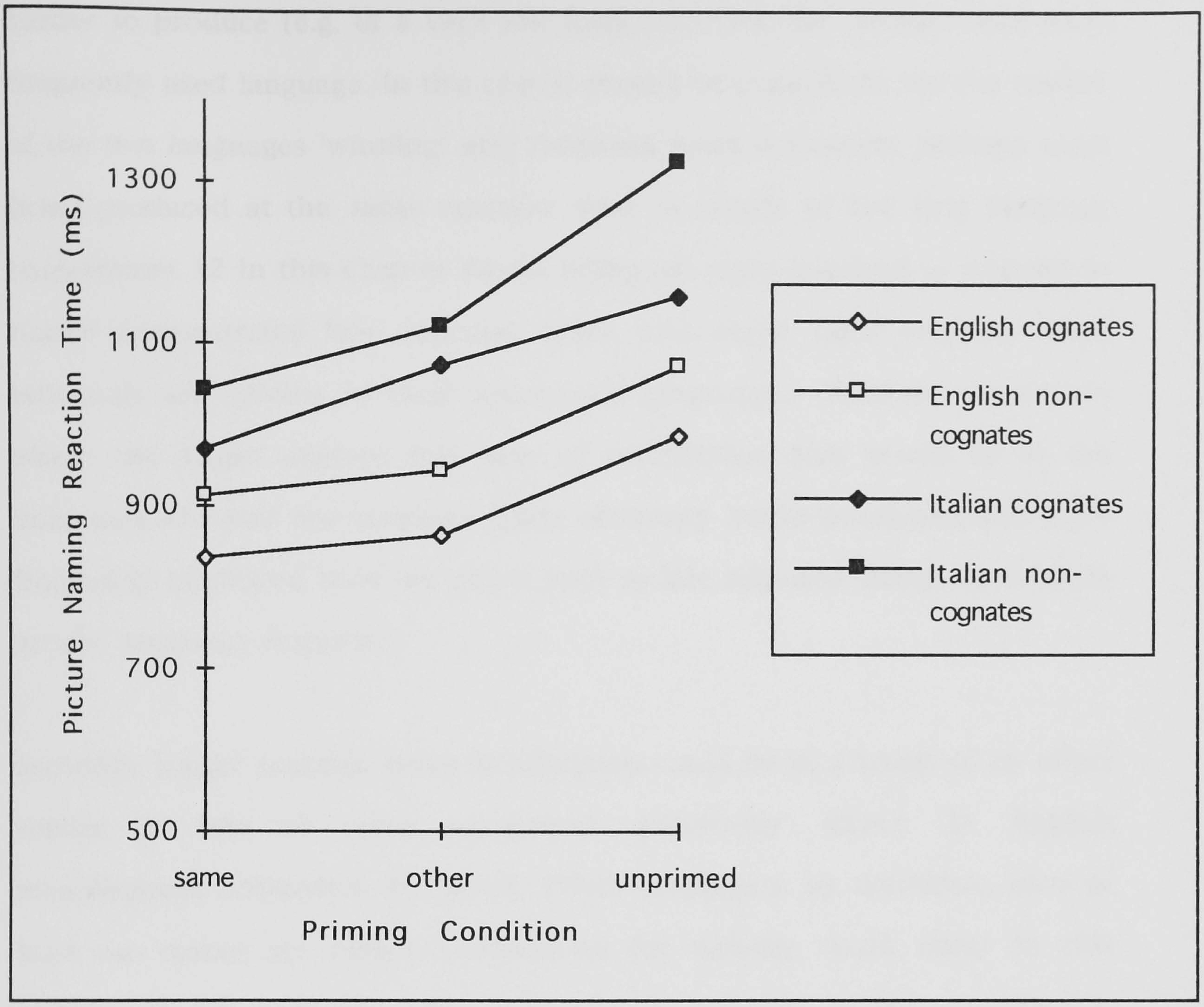
General Discussion

Experiments 9 and 10 found that bilingual participants showed longer reaction times than monolingual participants in object and in word naming. There are several possible reasons as to why this should occur.

The first reason is competition between two languages. Although bilinguals were 'switching off' their lesser used language which should require less effort, a second language existed nonetheless, and ignoring it required some cognitive effort. When a bilingual selected a response (s)he would have had at least one other competing item represented. This notion holds several implications. It implies that the more distinct two languages are, the easier one of them would be to choose over the other as its items would be more salient in one of the languages. In terms of language selection, then, it would be possible to see the exertion of effects of temporal constraints on language switching. Switching from L1 to L2, back to L1 and into L2 again under speeded conditions would show lengthening of reaction times as a result of competing systems, or as a result of a language switch being activated and deactivated. This is precisely what Meuter and Allport (1999) found. Longer reaction times were found for bilinguals naming numerals in either their

Figure 5.6

Mean Reaction Times from Phase 2 Naming in Experiments 11 & 12 (n=24)



first or second language unpredictably for switch trials than for non-switch trials. The cost of switching languages was more when switching to L1 from L2 than vice versa (this will be explained in further detail with regards to the latter two experiments in this chapter).

The notion of competing languages also implies that one language could be given a 'boost' in order to ease the competition between languages. In other words, the demands of one of the languages could be eased in order to lessen the competition between two languages. This could be achieved by using words which are easier to produce (e.g., of a very high frequency) for the weaker language and less frequently used language, and those which are harder to produce (e.g. of a very low frequency) for the stronger and most frequently used language. In this case it should be possible to see the weaker of the two languages 'winning' and receiving more activation, perhaps even being produced at the same reaction time as words of the first language (Experiment 12 in this chapter where bilinguals were required to respond in Italian demonstrated how reaction times and error rates increase when bilinguals are naming in their lesser-used language). Another manner in which one might explore this ease of competition idea would be to use bilinguals who had one language quite obviously better-developed and more frequently employed than the other; such as late acquired bilinguals or even second language acquirers.

Secondly, longer reaction times in bilinguals could be as a result of an effect similar to that of name agreement previously shown in English monolinguals (Vitkovitch & Tyrrell, 1995). Bilinguals, by definition, have at least two names per object. Competition for naming could occur in this manner. If this were the case, it should be possible to see monolingual-length reaction times from bilinguals naming objects which are *culture specific*. For example, a kettle is an item that is very common in English culture but very uncommon in Italian culture. Many of the bilinguals in these experiments are likely to acquire the Italian name for kettle (*bollitore*) later in life - if ever, given the improbability of using the item in Italy - and would use it the Italian word *bollitore* less frequently. For this item, and for other culture-specific items, then, reaction times ought to be very similar for bilinguals and for monolinguals.

To a degree, this explanation also holds as to why pictures with cognate names were named faster than those with non-cognate names. The cognateness effect may be interpreted in several manners. Firstly, it may have occurred because of an effect similar to that of name agreement in the monolingual literature. Vitkovitch and Tyrrell found that items which had low name agreement because they had more than one name were named slower than items which had more than one name because they were abbreviated (e.g. *plane* for *aeroplane*). Items with cognate names could be behaving in the same manner as these abbreviated names, which have high overlap even within one language. One problem with this name agreement explanation is that although it can account for longer reaction times for non-cognate items in *picture* naming, the effect should disappear with *word* naming, which is an unambiguous task: the stimulus provides a directly language-specific, non-semantic specification of the response and little selection from the rest of the lexicon is required. However, the longer reaction times for the bilinguals compared to the monolinguals were still present for the word reading task, although there were only marginal effects of cognateness.

Another explanation for the cognateness effect may be available from examination of the languages per se. Reading aloud in Italian should require less semantic involvement, given that it is a regular and transparent language, and there is generally only one manner in which to pronounce a phoneme. The English language, instead, is irregular and opaque, with more than one manner in which to pronounce many of the phonemes. Lengthened reaction times for these bilinguals' reading of English could be due to their employing a different strategy to reading aloud in English than an English monolingual participant would. The lengthened reaction times could *even* be due to words competing at a phoneme level. If competition occurs between the two languages of a bilingual, there is a possibility that this competition could extend to some of the phonemes in the unselected language competing for production. To a degree, then, having a bilingual experimenter as was the case in these experiments could even be something of a setback, as a bilingual experimenter may not be as sensitive to the subtleties of mispronunciation of phonemes as a monolingual experimenter would. One way of controlling for this could have been by recording the bilingual participants' responses and asking monolinguals to rate them for pronunciation.

A third reason which, in many ways, is connected to the name agreement explanation is that the bilingual may take longer to name because of changes in frequency. If we take a balanced bilingual participant (similar to the type involved in the experiments here) and assume that (s)he speaks English in the work environment and Italian in the home environment, each of which constitutes 50% of the bilingual's life, it is possible to see how the frequencies of either language are not as those of the monolingual. In terms of concepts, the bilingual living in England will see, say, kettles as much as any monolingual English person would. The difference is that in terms of naming there is a chance that half the time the bilingual would name it in Italian and the other half of the time in English. Thus, the frequency value for the word *kettle* in English for the bilingual would be half the value than for a monolingual English speaker (and also a monolingual Italian speaker). So, in terms of semantic variables there should be no difference between monolinguals and bilinguals but lexical variables should see bilinguals at something of a disadvantage - depending, of course, whether one regards speed or quantity as being more important.

In addition, lengthened reaction times may be attributed to these effects of competition, name agreement and frequency but one further reason which has been completely overlooked in the literature is that it may be to do with age of acquisition. Although the bilinguals in this chapter have been referred to in terms of their *dominant* language (which is English) most have Italian as their first language. All of these bilinguals are of Italian parentage and were brought up in homes where Italian is the preferred language. Many of them had been exposed to Italian from birth to the first few years of life, with English "leaking" through via the outside world or older siblings. Thus, given that the bilinguals are residing in the UK for roughly eleven months a year, English may be regarded as the more dominant and frequently used of the two languages, although Italian is the *earlier acquired* of the two. It would therefore be expected that bilingual AoA ratings would show later acquisition ages for most English object names when compared to English monolingual ratings. In addition, it would be expected that bilingual frequency ratings would show lower frequencies for words in either language, but familiarity ratings and visual complexity ratings to be the same for both monolinguals and bilinguals (apart from for items which exist in one culture but not the other).

For the monolinguals, instead, there was no difference between naming or non-cognate items, because these participants had no knowledge of the Italian language and so every item was behaving as though it were a non-cognate. In addition, monolinguals were faster by sheer nature of only having access to representations for one language. Therefore, the cognateness effect may be interpreted in terms of the language groups utilised. The bilinguals in these experiments may be slower at picture naming than monolinguals because of their knowledge of Italian. That is, it may be that knowledge of the Italian language is slowing participants down.

This can be related back to Experiments 2 and 4, where native speakers of

Italian named pictures and read aloud their written names slower than English participants. The mean reaction time for these (Italian monolingual) participants was 1035 ms for picture naming and 583 ms for word naming, in comparison to a mean RT of 868 ms for picture naming and 561 ms for word naming by the English monolinguals. In these experiments however, the English-Italian participants showed the slowest RTs of all, at 1083 ms for picture naming and 667 ms for word naming. An additive factor to being slower because of being Italian, then, may be the fact that the bilingual participants also have more than one name per item in their lexicon. Therefore, the bilinguals are slower because of the added load associated with speaking Italian (in terms of extra retrieval of lemma information and speaking a language containing an abundance of diminutive and dialect names) and also because of the aforementioned costs associated with being bilingual per se, which include having more than one name per concept, and the cogntive load required to ignore one language whilst activating the other.

Turning to the priming experiments, it was found that the difference in RT between items with cognate and non-cognate names was present in these two experiments. Cognates showed faster RTs when being named than non-cognates. This finding simply replicates Experiments 9 and 10. The difference was especially apparent for the unprimed condition when participants were naming in Italian, their less strong language (there was a difference between 165 ms between cognate and non-cognate items). It appears, then, that there is something to be gained from naming an object in L2 if it is similar to the L1 name.

However, the difference between naming cognates and non-cognates in Italian after having named them previously in English (i.e. the 'other language' condition in Experiment 12) indicates some competition. There was only 88 ms' worth of facilitation gained for the cognates but 203 ms facilitation gained for the non-cognates. Similarly, in English, other-language priming is almost as good as same-language priming. In Italian, other-language priming is less effective than same language priming. This replicates the suggestions of Kroll and Stewart (1994) that Language 1 to Language 2 translation occurs conceptually but Language 2 to Language 1 translation occurs lexically. There is a possibility that accessing a cognate in L1 and then in L2 facilitates its production in L2, but accessing it in L2 and then in L1 produces inhibition. The cognates compete at a lexical level from L1 to L2 production, but when the process occurs vica versa there is no lexical competition because the item is being produced via a conceptual route.

It was expected that recognising a picture twice would prime across languages because of the perceptual aspects in accessing the stored structural description on two occasions (i.e., in seeing the same picture twice). However, it was expected that priming from accessing the phonology would cross languages for the cognate words but not for the non-cognate words. This is not true for these results - cross language priming was also present for non-cognates, although it was less for naming in Italian than for naming in English. One explanation for this is that, although the cognate sets were matched for how many phonemes they shared across languages, the non-cognate sets were not matched for how few phonemes they shared across languages. Let us consider the non-cognate pair *donkey - asino*. Although it was considered a non-cognate pair, out of its five phonemes the Italian word has in common with the English word the two phonemes *o* and *n*, although not in the same order. Bilingual models such as Grainger and Dijkstra's (1992) Bilingual Interactive Activation model (BIA) emphasise how it is unlikely that bilinguals can operate without any interference from the non-target language. Grainger and Dijkstra argue that even in a purely monolingual mode, where there is no overt use of the other language "...lexical representations that share orthographic information with the stimulus are simultaneously activated independently of which language they belong to". One plausible explanation for the emergence of cross-language priming in these experiments is that lexical representations sharing phonological information with the stimulus are *also* activated simultaneously. For cognate names, it may be that sharing phonemes across two languages produces competition between the two names (hence only 88 ms' worth of priming for these) but for the non-cognates, having phonemes in common across two languages *benefits* the speaker, hence 203 ms' worth of priming for these.

Lastly, in each of these two priming experiments, participants were spoken to in English when performing in English and Italian when performing in Italian. This resulted in a switch into the other language and then back again at least once within the span of the experiment. If a language switch slows down the reactions of a bilingual participant, lengthened reaction times overall could be influenced by this. Further studies could employ fresh sets of participants per condition - although in this case there would be a cost with regards to controlling for individual variation.

In sum, the story does not appear very positive for bilinguals in that lengthened reaction times are found even in their performance in their first language. All is not negative, however, for as Mägiste emphasises, although there are situations where responding fast is an advantage, there do exist compensatory advantages of being multilingual, and several studies (Cummins, 1978; Mägiste; 1979) suggest that being bilingual is advantageous for tasks involving metalinguistic awareness and in generating synonyms.

Chapter 6

The Cognitive Neuropsychology of Bilingualism - The Wax and Wane of Two Languages

6.1. A Cognitive Neuropsychological Approach

So far, this thesis has explored unimpaired lexical processing using reaction time studies. These inferences from reaction time studies alone can provide only a partial picture of language processing. The empirical field of neuropsychology attempts to link cortical structures to functions, but it is by applying a cognitive neuropsychological approach that renders it possible to relate neuropsychological disorders to the existing cognitive models. The application of neuropsychology results in detailed descriptions and explanations of single cases, as opposed to comparing groups of patients who may not have the same underlying deficit.

The approach of cognitive neuropsychology has not been without its criticisms, however. Shallice (1988) has argued that cognitive neuropsychology has taken too far the argument that group studies are not fruitful in the construction of cognitive models, which has resulted in what Shallice terms 'ultra-cognitive neuropsychology', and a salmagundi of controversy (e.g. Bates, McDonald, MacWhinney & Appelbaum, 1991; Caramazza, 1986; 1991). Similarly, Seidenberg (1988) identifies that another weakness of cognitive neuropsychology has been in its placing much emphasis in the revealing of functional architecture and components involved, at the expense of the exploration of actual processes. This, he argues, has resulted in a superfluity of box and arrow diagrams with little description of the functions occurring inside these boxes. Bearing these issues in mind, cognitive neuropsychology and neurophysiological techniques such as noninvasive brain mapping and imaging techniques can provide some empirical evidence of how the lexicon is presented and organised in the brain. This chapter provides a short literature review of the cognitive neuropsychology of bilingualism, and the next chapter provides detailed explanation of a patient with these points in mind.

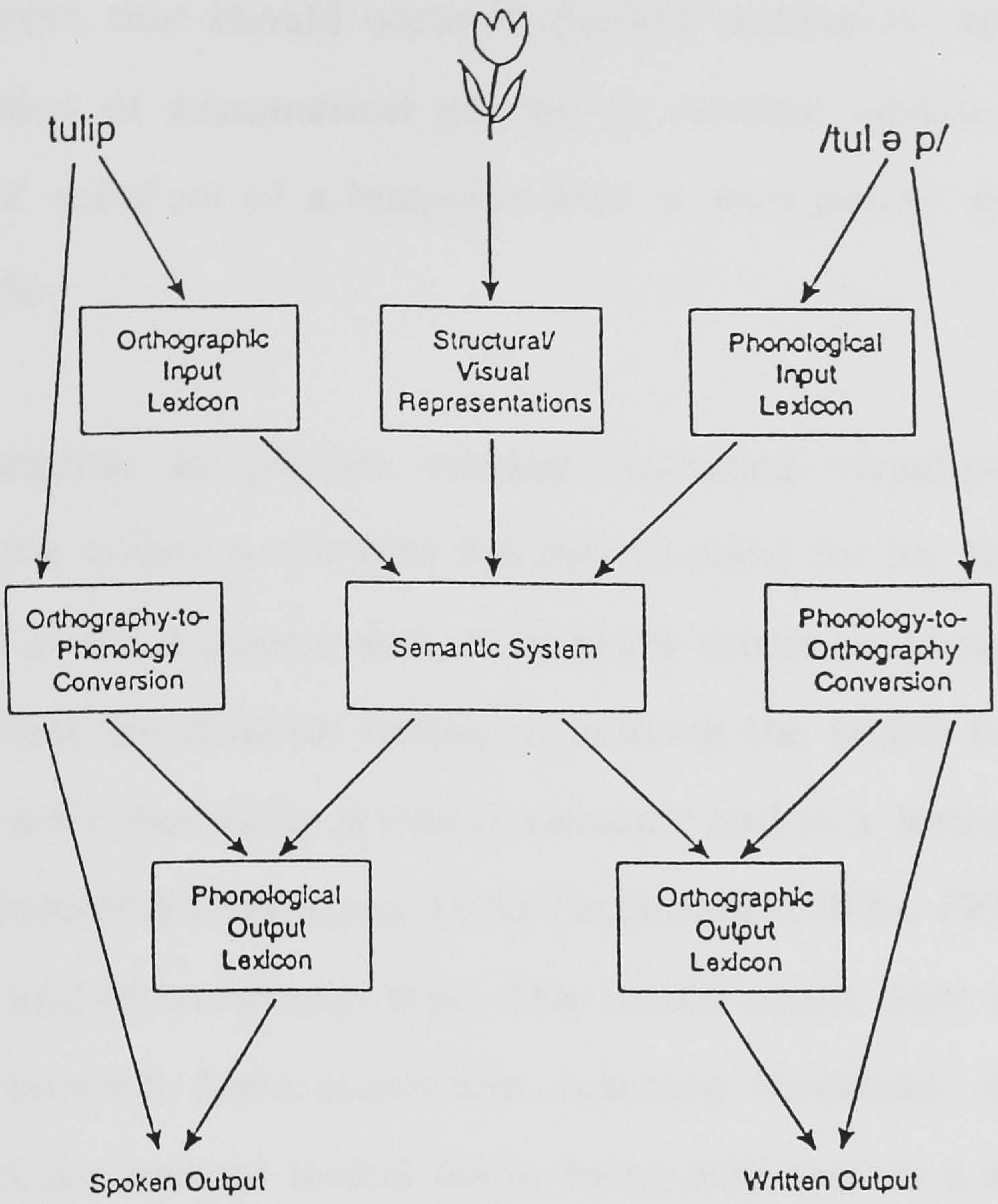
6.2. Aphasia in Monolingual Speakers of English and Italian

The most common finding in aphasia is the inability to produce the correct name to a presented picture (Goodglass & Kaplan, 1983) although only a few studies have described patients with 'pure anomia' (Kay & Ellis, 1985; Miceli, Giustolisi & Caramazza, 1991). Most studies of monolingual aphasia (e.g. Caramazza & Hillis, 1990; Hillis & Caramazza, 1991; Miceli, Giustolisi & Caramazza, 1992; Miceli, Amitrano, Capasso & Caramazza, 1996) have used a functional architecture of lexical processing as in Figure 6.1. This framework has generated many hypotheses concerning the mechanisms involved in normal word comprehension and production and operates as a basis for inferring possible loci of lesions responsible for errors observed in a patient, thus permitting a treatment program to be devised (e.g. Miceli et al., 1996).

Object naming entails activation of a set of semantic features in the lexical-semantic system which activates, in turn, all entries in the output lexicon whose meaning comprises of the activated semantic features. The total of activated entries is partly dependent on how much they match the full representation, so if a response were required to name the object 'knife', the phonological form for /naif/ would be activated above threshold whilst lexical forms for /spu:n/ and /fOrk/ and other objects sharing semantic features with knife would be activated to some degree, but items with no semantic information in common with knife might be partially activated, but

Figure 6.1.

Schematic representation of the functional architecture of the lexical-semantic system (from Miceli, Amitrano, Capasso & Caramazza, 1996)



failing to reach threshold, would not be produced.

Other tasks which also require a word's spoken presentation - such as reading aloud and repetition - share processes with object naming, by requiring activation of lexical-semantic information by an input representation, which is structural in nature for object or picture naming, orthographic in nature for reading and phonological for repetition. For reading aloud and repetition, however, the input is processed by the procedures occurring in object naming, but also by sublexical procedures which map graphemes to phonemes for reading, and input phonemes to output phonemes for repetition. These procedural differences for each task hold certain consequences, both for the error types which should occur for each task as a result of damage to a particular component, and also for the error types that should occur in picture naming for speakers of a language comprising of grammatical gender. In reading, certain consequences would arise for speakers of a language with a transparent grapheme-to-phoneme mapping.

With regards to picture naming, assuming visual-perceptual analysis is intact, the failure to provide the correct name for an object could arise from damage at the semantic system, whereby errors could result from incomplete conceptual information failing to activate the target form above threshold. The errors observed in a lexical semantic and in a lexical form deficit (Hillis, Rapp, Romani & Caramazza, 1990; Caramazza & Hillis, 1990) would therefore be similar and of a semantic type. This would result from a semantically related (but incorrect) form sometimes reaching threshold, or from none of the semantically related lexical forms being activated to a greater level than the others - in which case, a correct response could still be produced but it would be by chance or good fortune.

With the tasks of reading aloud and repetition, with lexical semantic or lexical form damage, performance is dependent on how much damage has occurred in the sublexical conversion process for each task. In the presence of a damaged orthography-phonology conversion route, both lexical semantic and output lexicon damage would result in the patient producing semantic errors as in picture naming. If, however, the sublexical orthography-phonology conversion route remained even partially intact, the addition of sublexical and lexical information from semantics could block semantically related, competing responses, and in some cases activate the target response. In the case of complete preservation of this conversion route with the absence of lexical-semantic information, reading would occur via this sublexical conversion. In English, regularisation errors would be apparent, such as those made by Marshall and Newcombe's (1973) patient JC. Therefore, knowledge of the reading of *tint* and *mint* could aid the reading of *hint* but not *pint*. In Italian, however, orthography is only opaque at the suprasegemental level, so although knowledge of the reading of *cane* ('dog') could aid reading aloud *pane* ('bread') and *rane* ('frogs'), other words with almost identical strcucture can differ in stress position, such as *solito* /'sOlito/ ('usual') and *salito* /sa'lito/ ('climbed'). Some words may even share exactly the same structure but have two pronunciations differing in stress, such as *ancora* which may be pronounced as /anc'ora/ ('anchor') and /anco'ra/ (still, yet). With damage to lexical-semantic or lexical form components, lexical information would be unavailable, and so there would be over-reliance on the sublexical conversion route. This would result in stress errors in Italian, such as those of Miceli et al.'s (1996) patient, GMA who produced /epi'dEmya/ for *epidemia* ('epidemic' - correct pronunciation: /epidE'mia/ and /li'brErye/ for *librerie* ('bookshops' - correct pronunciation: /librE'rie/).

With regards to agrammatic aphasia, according to Miceli and Mazzucchi (1990), agrammatic patients substitute both bound and free grammatical markers, which is crucial for Italian patients and for speakers of other richly inflected languages, which differ from English in a number of aspects. The nouns and adjectives in these languages are marked for gender and number, verbs for person, aspect and mode and the root of inflected nouns is specified by a phonological form not corresponding to other words in the language. For example, the root '*piccol*' in Italian is the root for the adjective 'small', which must be inflected to *piccolo* for the masculine singular form, and to *piccola* for the feminine singular, *piccoli* for masculine plural and *piccole* for feminine plural forms. Similarly, '*parl*' is the root of *parlare* 'to talk', which then takes appropriate inflections for various verb forms, e.g. *parlò* - '(s)he walked'. A model of speaking such as that of Levelt (1989) and Levelt, Roelofs and Meyer (1999) (see Figure 1.2. in Chapter 1) shows where these inflections are encoded in such speakers, and how a selective impairment in accessing grammatical properties of nouns and verbs but not their phonological forms would lead to a patient such as Miceli and Caramazza's (1988) F.S. This patient produced strings of spontaneous speech which were inflectionally related, such as: '*Poi io ascolto il televisione perché il giornate {sono} lungo*' ('then I listen [to] the television because the days [are] long'). Here, although the retrieval of the phonological forms for *televisione* and *giornate* was correct, they were not accompanied by the correct retrieval of the definite article (*la* and *le*, respectively) and of the appropriate inflection of the adjective (here, this should have been *lunghe*).

In terms of Levelt's model, this represents a case where the lexeme of a word is correctly retrieved, but the syntactic features, or lemma, of a word has not been activated sufficiently, although Caramazza and Miozzo generally argue against the lemma/lexeme distinction (Caramazza, 1997; Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997). They suggest that there may be parallel access from semantics to word-specific syntactic representations (equivalent to lemmas) and phonological representations (equivalent to lexemes), instead of lemmas preceding lexemes in a two-stage process. As a result, they note that if parallel access to gender as a feature of syntax, and access to phonology exists, then an impairment to phonological representations or inability to access them could lead to the same pattern of results - of patients who know the gender of object names but are unable to access those same names. Patients should therefore show a pattern of results similar to those of F.S., although there are no reports of patients who show phonology without gender in existence, in comparison to cases of patients showing preserved gender without phonology such as Badecker, Miozzo and Zanuttini's (1995) account of Dante, an Italian aphasic who was able to produce the grammatical gender for items he could not name.

6.3. Issues in Bilingual Aphasia

Studies of unimpaired bilinguals have concentrated on both the fact they have the capacity to switch off one language as well as their activation of both languages simultaneously, e.g. in cases of code-switching and borrowing and on bilinguals' speech modes. Language mixing in the speech of bilingual aphasics is an issue which has been somewhat controversial (Perecman, 1984; Grosjean, 1985) as it is not always the case that bilingual aphasics' language mixing is due to some form of language deficit. Although case studies such as those of Albert and Obler (1978) and Paradis (1983) indicate that certain cases of language mixing occur because of a deficit, to some extent language mixing occurs for reasons unrelated to any deficit. Grosjean (1989) identifies a number of methodological points that arise in collating data from bilingual aphasics. Issues such as the wrong base language used with a monolingual interlocutor, extensive code-switching constraints or rules, language mixing during the reading of monolingual text and failure to translate upon request, all of which may all lead to a breakdown in communication between experimenter and patient. Many case studies rarely distinguish between mixes which occur as a result of an underlying disorder, and those which would have been acceptable in normal bilingual speech. Language mixing by bilingual aphasics can reflect language and conceptual deficits but could also occur as a result of communication strategies employed by both normal and impaired speakers. Hence, the ideal testing situation with regards to bilingual aphasics would be one involving a bilingual experimenter with knowledge concerning the language behaviour of the patient pre-morbidly. An error in pronunciation could, after all, reflect the patient's normal linguistic knowledge prior to injury. It is also imperative that studies report the language mode that the bilingual aphasic was tested in. If one is to adhere to Grosjean's (1997) viewpoint of a bilingual's languages operating on a continuum, the location of the patient's language on the continuum during testing sessions is of concern.

Two of the first reports to suggest that bilingual aphasic patients behave differently to monolingual patients were the now much-cited studies by Paradis (1977) and Albert and Obler (1978). Different patterns of breakdown were identified in patients, as well as different types of recovery, such as selective and antagonistic recovery, which may reflect language storage and lateralisation. It was this initial noting of differences between mono- and bi-lingual performance that led researchers to develop batteries to assess breakdown of language in bilingual patients, such as the frequently mentioned Assessment of Bilingual Aphasia (Paradis & Libbens, 1987). A number of traditional assessment batteries have been increasingly translated into other languages - for example, the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983) which has been translated into French (Mazaux & Orgozo, 1981) and Finnish (Laine, Goodglass, Niemi, Koivuselka-Sallinen, Tuomainen & Marttila, 1993). This is particularly useful and valuable, both for assessing language performance in monolingual mode and in that they have made explicit a number of points which also appertain to other areas of bilingualism in normal speakers. Among these points include: provision of detailed descriptions of the bilingual's language knowledge, use and skill prior to injury, specification of how much of the interference occurred in each language when the speaker was in monolingual mode, amount of time spent in bilingual mode and the types of mixing that occurred, who the patient code-switched with, and the standard of the patient's translation abilities. With regards to post-injury, Grosjean (1989) suggests that the bilingual patient be tested in monolingual mode. Studies of 'normal' bilinguals have concentrated on their activation of both languages (cf. studies on code-switching, borrowing and on bilinguals' speech modes). Having examined these from an unimpaired speaker's perspectives, Grosjean suggests that the patient is tested in each of the two languages at different times and with different examiners who have no knowledge of the other language. This would thereby force the patient to engage in a monolingual speech mode. Grosjean and Roberts (1998) also suggest the patient be tested in bilingual speech mode by a bilingual experimenter, even alternating language within a single test session. This would allow for investigation into appropriateness of language choice (i.e. whether the patient speaks the 'wrong' language to another bilingual), whether mixing occurs to the same degree as it did pre-injury, and whether the patient can translate from one language to the other at the same level as (s)he could before the injury.

6.4. Bilingual Lateralisation in Unimpaired Speakers - More Than Two Sides to the Story

"...It would be surprising if bilingualism had no effect on brain organisation..." (Segalowitz, 1983)

Neuropsychological studies of monolinguals have demonstrated that language processing and production is mediated by an assigned cortical network, which, for most speakers, is located in the anterior part of the perisylvian areas of the left hemisphere (Damasio, 1992). A long-standing matter of debate in bilingualism is whether the languages of bilinguals are less asymmetrically represented in the cerebral hemispheres than the language of monolinguals, and whether L2 acquisition is consistently associated with a cerebral structure comparable to that of L1. Researchers have taken a range of approaches. These vary from the belief that greater symmetry exists in the representation of both languages, to the belief that greater right hemisphere participation exists only for the stronger or weaker language, for languages acquired early or late, formally or informally and depending on whether the speaker is at the beginning or advanced levels of learning (Mendelsohn, 1988; Paradis, 1990, 1992; Vaid, 1983; Vaid & Genesee, 1980). Part of this divergence in opinion stems from task differences in experiments, as certain procedures produce results suggesting involvement of the right hemisphere whilst others do not (Vaid & Hall, 1991).

The belief that *different* cerebral systems support acquisition and processing of L1 and L2 stems from a number of experimental sources. Cases of dissociation where a polyglot becomes aphasic after a brain lesion, in only one of the languages originally learned have been reported by Albert and Obler (1978) and Paradis (1995). These findings are further supported by evidence from electrical cortical stimulation (Ojemann, 1983) who suggests that the brain areas required for the learning and processing of L1 differ from those recruited for L2. Studies by Ojemann and Whitaker (1978) and Rapport, Tan and Whitaker (1983) also suggest that primary and secondary languages are represented in different cerebral regions. In these experiments, however, bipolar electrodes 5 millimetres apart were used, with some spreading at each end, and so it is difficult to be sure that the same cortical areas were stimulated on separate occasions. Brain imaging of bilingual participants is fast becoming a popular method of investigating bilingualism, and a number of studies (Klein, Zatorre, Milner, Meyer & Evans, 1995; Perani, Dehaene, Grassi, Cohen, Cappa & Dupoux, 1996; Weber-Fox & Neville, 1996; Yetkin, Zerrin Yetkin, Haughton & Cox, 1996; Kim, Relkin, Lee & Hirsch, 1997; Dehaene, Dupoux & Mehler, 1997) have revealed differences between L1 and L2 representation. The problem with these studies, and perhaps the reason why a consistent neuronal substrate for L2 has not been located, was that they used disparate languages and tasks, and the patients and participants spoke L2 to differing abilities, thus preventing the emergence of consistent patterns of results.

As has become evident in the experiments reported in this thesis, one variable of importance in lexical processing is age of acquisition. The influence of AoA extends to the field of bilingualism. One of the factors affecting the cortical representation of a language is the moment in life when it was acquired. Mayberry (1993) suggests that delayed learning of a single language results in an impoverished vocabulary; and historically, studies (e.g. Lenneberg, 1967) have investigated the notion of a critical period of language acquisition, especially with regards to the difficulty in learning a second language after puberty. It has commonly been found that children learn second languages with more ease than do adults (Johnson & Newport, 1989; Flege, Munro, & Mackay, 1995, Weber-Fox & Neville, 1996).

Kim et al. (1997) used fMRI and the unconstrained and covert task (describing what they had done during the morning, afternoon and evening, using internal speech) to study the representation of L1 and L2. Of their proficient bilinguals, six had been exposed to both L1 and L2 during early infancy, and six began learning their second language after puberty.

They included participants with different pairs of languages (i.e., not a homogenous group). Kim et al. found that in their group of late learners, L1 and L2 were represented in spatially segregated parts of Broca's area (the left inferior frontal cortex). In early learners, however, overlapping parts of Broca's area were activated for both languages.

Perani et al.'s (1996) PET study involved 'bilingual' participants (although they are described as bilingual, the participants had only a moderate command of English). Whilst the participants listened to stories in Italian, a large set of areas in the left hemisphere were activated, including perisylvian regions and temporal poles. When the same participants listened to English stories, however, a more reduced symmetrical circuit within the superior and middle temporal gyri was activated. Similarly, in a study employing functional MRI, Dehaene et al. (1997) showed that whilst, for L1, similar brain networks were involved in all participants, the brain networks involved in L2 varied from participant to participant. Again, the main problem with this study lies in the fact that the participants were not balanced bilinguals, having only a moderate command of L2, that is, speaking it to a low proficiency. The different pattern of activation could therefore be attributed to either age of acquisition or level of proficiency.

Perani et al. (1998) attempted to disambiguate between AoA and proficiency by keeping proficiency constant whilst comparing a set of early- and late-acquired L2 bilinguals. That is, they compared two experiments on participants who had learnt L2 to a high degree of proficiency but who differed in their age of acquisition of L2. Their two groups were more homogenous in that they consisted of a group of 12 Spanish-Catalan bilinguals who had spoken both languages for most of their lives and were proficient in both (high proficiency, early acquired - HPEA - group) and a second group of 9 adult male Italians who had learned English after ten years of age, had stayed in an English-speaking country for more than a year and who had "achieved excellent English speaking skills". The Spanish-Catalan group was used as the HPEA group, because the authors were not able to find a population of HPEA Italian-English bilinguals (this group of bilinguals, was in fact, the type used in this thesis). The two groups of participants had their proficiency assessed with word translation tasks of three lists of low, medium and high frequency words from L2 to L1. Perani et al. compared the results on this translation task for the HPLA group of participants with the group of low proficiency, late age of acquisition (LPLA) participants from Perani et al. (1996), using this latter group as a further control. The group of LPLA participants consisted of 9 male Italians who had mastered English to a moderate level, none of whom had been exposed to English before the age of ten years, and none of whom had stayed in England for more than one month. In comparing this LPLA group with the HPLA group, main effects of frequency were found irrespective of group, and the groups scored almost identically for translation of words of a high frequency but the HPLA participants performed significantly better than the LPLA participants overall.

With the two, HPEA and HPLA groups, Perani et al. (1998) performed a PET study, taking cerebral blood flow measures. For the HPLA group of nine Italian-English bilinguals, these were taken as they listened to a story in Italian, one in English and one in Japanese, and baselines of backwards Japanese and attentive silence were measured. For the twelve Spanish-Catalan bilinguals, cerebral blood flow measures were taken as they listened to a story in their dominant language (for half the group this was Spanish and for the other half, Catalan) in L2 and in Spanish and Catalan played backwards, and a baseline of backward speech was taken.

For the high proficiency, late acquired group, there was little difference in patterns of brain activation between them listening to their first or second language. When they were listening to stories in their L2, activation was found in the left temporal pole, the middle and posterior temporal gyri and bilaterally in the hippocampal structures. For the LPLA group performing in L2, however, no activation was found in the temporal poles or left anterior and posterior part of the middle temporal gyrus. The main finding, therefore, was that for the HPLA group, there were no significant activation foci in direct comparisons of activation when English and Italian stories were presented. For the HPEA group of bilinguals, the pattern of results was similar to that observed for the HPLA group when the activations observed for listening to L1 or L2 were compared to backward language. The same areas of the temporal poles, hippocampal structures and lingual gyrus and of the left side were activated, but some regions were activated for one language and not for the other, and these differences were all in the right hemisphere. According to these findings, it must be the degree of mastery and attained proficiency, not age of acquisition, that causes the differences observed between the two groups; although the data do not question the notion that AoA is a major determinant of L2 proficiency.

6.5. Lateralisation, Localisation and Bilingual Patients.

"...Where was that gentleman's Greek deposited that it could be blotted out by a single stroke, while his native language and all else remained?" (Scoresby-Jackson 1867)

Scoresby-Jackson asked the above question after the case of an Englishman who selectively lost his knowledge of Greek following a blow to the head.

Since it was believed at the time that the locus of the brain employed to learn the native language is in the foot of the frontal convolution (Broca's area), it was supposed that any other languages learned would be encoded in the rest of the convolution.

Against this theory of differential localisation was Pitres (1895), who argued that there are at least four cortical areas subserving language, two being sensory and for both aural and written comprehension, and the other two being motor, for speaking and writing. Selective loss of one language would mean that each area would need to be selectively damaged in the part serving that language only, and not the other. As Paradis (1997) points out, a distribution of lesions of this nature would be impossible and could not occur with the same frequency that nonparallel recovery occurs.

Patient studies have not only demonstrated partially different locations and greater participation of the right hemisphere for a bilingual's two languages, but have also revived the notion of each language being represented in different locations of the same (dominant) hemisphere. Evidence for this comes from cases of differential recovery, whereby patients display the same symptoms for each language, but to different degrees (Junqué, Vendrell & Vendrell, 1995; Paradis, 1977) and from cases of differential aphasia, where patients display different symptoms for each language (Albert & Obler, 1978; Silverberg & Gordon, 1979). The latter occurrence, however, has been questioned by Paradis (1993), as these cases may be re-interpreted as cases of selective loss. Pre-morbid proficiency in both languages is not always reported, and not always of an equal level, and this may be exacerbated by the aphasia. Silverberg and Gordon's (1979) case 1, for example, a patient with differential aphasia, was described as having conduction aphasia in Russian (his native language) and global aphasia in

Hebrew, which he had attempted to learn pre-morbidly over several years, but with little success. This case may also be seen as a one showing selective loss in Hebrew. Albert and Obler's (1978) and Silverberg and Gordon's (1979, Case 2) patients were reported to be suffering from Wernicke's aphasia in the second language (Hebrew) and non-fluent aphasia in their other languages (Spanish, Hungarian or English). One issue of importance here, is that these diagnoses for Wernicke's aphasia were made on the basis of substitutions of inflections for Hebrew, and on the omissions of inflections for the other languages. As Paradis (1997) points out, this may simply reflect a case of agrammatism for all languages, with it being displayed in one manner for Hebrew and in another for the other languages. Again. these studies do not mention the level of premorbid proficiency between the languages of each patient.

Paradis (1987) identified a number of possible organisations of bilingual lexical organisation, and related these to patient reports. The extended system hypothesis, where languages are diffusely represented in the same cortical areas, predicts that the bilingual speaker has more choices among linguistic elements, which is undifferentiated. As the bilingual learns the second language, either alongside or after the first, additional phonemes to be used only in L2 environment are processed, and so the stock of linguistic elements is extended. Consistent with this hypothesis is language mixing, parallel recovery and language blending of an aphasic's languages. It is difficult to account for selective and differential recovery using this hypothesis.

Contrary to this organisation, is the second hypothesis, entitled the dual system, whereby elements of the two languages are stored separately in independent underlying systems. This accounts for the fact that bilinguals are able to speak one language at a time without interference from the other, and also accounts for successive and antagonistic recovery patterns and selective loss. The hypothesis has difficulty in accounting for parallel deficits and language mixing.

According to the tripartite hypothesis, items that are identical in the bilingual's two languages are represented in a single neural substrate, whereas items which are different have their own, separate representation, thus eliminating the repetition of representations for items which are common across languages. This hypothesis is consistent with Ojemann and Whitaker's (1978) theory that there are some sites that are common to both languages, and others that are specific to each. There are also patient findings that are consistent with the tripartite hypothesis. The findings of Watamori and Sasanuma (1978) and Sasanuma and Park (1995) suggest that the transfer of benefits of therapy is limited to areas where the two languages are similar. That is, structural distance between two languages has an effect on language therapy (consistent with the ideas of Paradis, 1993). Many patient studies, for example, that of Stadie, Springer, De Bleser and Bürk (1995), have found that bi- or multi-lingual patients make fewer interlingual errors between structurally dissimilar languages then between structurally similar languages. The problem with this hypothesis is that it does not account for selective impairments. If the common elements of two languages are represented only once, it seems improbable that these representations would be available when the bilingual speaks one language but not the other.

Finally, compatible with all the patterns of recovery in bilingual aphasics reported so far, is the subset hypothesis. According to this hypothesis, a bilingual's two languages are served by two subsystems of a larger implicit linguistic competence system, distinct from other cognitive systems. Each subsystem has a nature more similar to the other language subsystem than to any other cognitive system but can be independently activated or inhibited.

Most of the patient literature therefore demonstrates that the languages of a bilingual do not have different and separate anatomical locations. According to Paradis (1993), some overlap between the two languages must exist, for if each language were served by separate neural circuits entwined within the same general anatomical area, patients with selective impairment would not be found. One other explanation is that selective impairment occurs because of an increase in inhibition, or a rise in activation threshold for one of the languages.

Paradis and Goldblum (1989) report a trilingual aphasic with selective impairment. This patient showed aphasic symptoms in only one of the three languages. The patient then showed spontaneous recovery for one of the three languages after a period of eight months, but by this time one of the other two languages became impaired. The authors account for this finding, not in terms of the two languages exchanging location, rather, in terms of differential inhibition. This notion of activation threshold and increase in inhibition is consistent with Green's (1986, 1998) theory encorporating the control of resources. Green assumes a bilingual's languages to be arranged in separate sub-systems, thus accounting for differential recovery. Slips of the tongue (in both patients and unimpaired speakers) occur through a lack of control. The presence of a *specifier* stipulates how much control is required over each language. According to Green, there are three states of activation. Firstly, when a language system is least used or unused it is *dormant*. When one of a bilingual's two languages is in use in the ongoing processes (but not necessarily spoken) it is *active*. Lastly, when a language system is controlling speech output, it is *selected*. If a bilingual wishes to speak a particular language, that language must first be selected and become highly activated whilst the other language, although remaining active, must be suppressed. In terms of inhibition then, it appears that it is sometimes impossible to disinhibit one of the languages permanently (which results in selective recovery), or temporarily (which results in selective recovery) or alternately (which results in antagonistic recovery). Furthermore, the activation threshold for one language may increase as compared to the other, resulting in differential recovery, and deactivation of one language may be difficult, which also results in involuntary mixing (Paradis, 1989).

6.6. The Treatment of Bilingual Aphasia - Is It Necessary in Both Languages?

There has been a great deal of controversy over whether speech therapy in one language of the bilingual transfers to the other. As with the other cognitive neuropsychological topics mentioned, the literature with regards to this topic is somewhat messy and disordered. Although there are many studies in existence, there is a certain unreliability and invalidity about the reports, which often lack formal or objective assessment, or rely on unmatched assessment, making use of translated tests (it is dangerous for one to assume that a translated test taps the same areas in the second language), and many studies have not controlled for spontaneous recovery.

With regards to whether the benefits of therapy transfer from one language to another, studies are divided. Voinescu, Visch, Sirian and Maretsis (1977) report a quadrilingual Romanian, Russian, Greek and German speaking CVA patient , whose treatment in Romanian transferred to the other languages in equal amounts. Watamori and Sasanuma (1978) report two English-Japanese Broca's aphasic patients. The first, patient had eighteen months of therapy in English. The patient only showed an improvement in receptive Japanese, and there was no change in written Japanese. It was only when therapy was concentrated in Japanese that an improvement in written Japanese was found. The second patient showed parallel receptive recovery but no written transfer from English to Japanese. A similar outcome was reported by Sasanuma and Park (1995), who describe a Korean-Japanese bilingual. After receiving three months' treatment in Korean, receptive improvement was generalised, despite there being less linguistic distance between Korean and Japanese than there is between English and Japanese, but there was no transfer in terms of expressive language. Lastly, Cheng and Miller (1998) reported a severe Broca's aphasic patient, who received treatment for semantic and phonemic paraphasia in Putonghua and Hokkien. Transfer was found in semantics, which are heavily shared across the two languages but not in phonology, which is not shared across the two languages.

Therefore, these studies show that in some cases, there is generalisation of treatment from one language to the other, but in other instances, no generalisation exists. In some cases, transfer occurs in comprehension but not in expressive communication, and transfer also occurs to variable degrees and qualities. The reason why transfer should occur to such varying degrees may be as a result of other confounding factors, including language distance, location of breakdown and cue cost/validity.

Language distance is calculated by estimating the difference and distance between two languages in terms of syntactic, morphological, semantic, phonological and graphemic differences. The studies reported have shown that generalisation occurs across the shared features in transfer, and so there is little that is shared beween English and Japanese language features, but more is shared between Korean and Japanese language features. However, if transfer were solely as a result of linguistic distance, only

Sasanuma and Park's Korean-Japanese patient would have shown transfer. Location of damage incorporates the notion of how the bilingual's two languages are stored. The less linguistic distance between two languages, the more likely it is that the two are held in a common store. This holds implications for therapy, in that treatment targetted at common stores should be more efficient, but in order to obtain equal amelioration across both languages, it is necessary to treat the separate stores independently. This factor cannot be the sole predictor of language transfer, though, as there are instances with shared features when generalisation of treatment occurs at different degrees. Cue cost and validity was introduced by Bates and Macwhinney (1989) in their competition model. Cue cost refers to how important a feature is for distinguishing meaning within a language, for example word order, inflections, whether words are aspirated or non-aspirated, etc. Whether a feature has high or low cue validity will contribute to whether transfer will occur from one language to the other. Even with the shared features of two languages, if a feature is of low cost or of low validity, it will be a less important feature of a language. Thus, of importance is not whether features are shared or separate *solely*. but also the centrality of each feature. Cue cost refers to the amount of processing capacity that a feature consumes. The more automatic and implicit a feature, the less cost there will be in terms of processing, but the more explicit a feature is, the greater the degree of propositional control required and thus the greater the cost.

There are many determiners of cost levels in a language. In bilingual speakers, some determinants include the age at which the languages were acquired, pattern of usage, method of acquisition and proficiency. Age of acquisition, as specified earlier, is an important variable, as the more early in life a language is learned, the more automatic processing in it becomes.

Many studies assume that when a second language is learned by a bilingual, the first language remains in usage but there are instances where the first language may lie dormant. There are also cases where the two languages are learned together, and these different patterns of bilingualism hold different implications in terms of cue cost, and in terms of lowered or increased thresholds for each language. The two languages of a bilingual do not duplicate, it is usually not the case that they are learned to the same degree or that they are used in the same environments. In some cases, for example, one language is used in the home and the other in the work environment, so this contributes to a distancing of the two languages, and transfer may be less likely to occur and hints at a case of transfer in receptive but not expressive skills, given that there is less cost for receptive skill.

To conclude, the amount of transfer from treatment of one language to the other is qualitatively and quantitaively determined by a number of variables which include language distance, locus of breakdown, specificity of therapy, age of acquisition of the languages and the patterns of usage of each language across the lifespan. Research into this topic is still lacking, and these issues are often overlooked in case studies and reports. Certain clinical implications are also overlooked in case reports, especially appertaining to the patterns of languages spoken and the history, mode and frequency of usage; as well as changes in patterns of usage (for example, whether the patient's usage of one language decreased when [s]he finished work or increased with the advent of grandchildren). It is now imperative that clinicians, therapists and psychologists consider these issues and the nature of the stimuli they use, employing words which are matched across languages on factors which affect monolingual naming (instead of simply providing a direct translation of existing tests for monolingual speakers) and considering the validity and relative processing costs of target stimuli.

Chapter 7

Case Report of Word-Finding Problems in An Italian-English Bilingual Aphasic

7.1. Bilingual Aphasia

The previous chapter discussed the merits of delivering speech therapy in both languages of the bilingual, and whether transfer in speech therapy occurs from one language to the other. This chapter provides a detailed case study of one such aphasic, testing her picture and word naming capacities in her first language of Italian and in her later-acquired second language, which is English. The fact that this patient's second language was acquired much later in her life than her first but used to almost the same frequency allows for exploration between the variables of age of acquisition and frequency. It is necessary to note here that this patient is not a bilingual of the type utilised so far in this thesis. The bilingual population studied in Chapter 5 is one where the two languages were learned and used more or less simultaneously. This patient is from the generation before, in the sense that Italian was her first and only language for a long span of time. However, her residence in England and the fact she worked and mixed in her environment rendered her fluent in English prior to (and to a large degree, also following) her stroke.

In the previous chapter, it was mentioned that assessment of bilingual aphasia is often carried out inappropriately. This is partly due to the field being a relatively new one. The literature is still somewhat disordered, with formal or objective assessment being omitted and unmatched assessments being reported. For this reason, choosing which tests to conduct on the patient was a rather arduous task; it is tempting to carry out a high proportion of linguistic assessments in English simply because they exist and are supported by control data. Although the dangers of using translated tests have been highlighted, they were still utilised with this patient - with great caution - for reasons that will be explained. The danger of using translated tests lies in the fact that the experimenter may easily assume that a translated test taps the same areas in the second language as it does in the first. A second danger lies in the fact that many studies have not controlled for spontaneous recovery.

These problems were taken into consideration and may be rationalised in a number of ways. Firstly, although translated tests were utilised, control data were obtained wherever necessary from age- and language-matched unimpaired controls. The group of controls included the patient's spouse who, on the whole, would have been exposed to as much of the two languages as the patient herself. Secondly, there was an advantage in the fact that the tests were translated and conducted by a bilingual experimenter. This allowed for a number of subtleties to be detected, such as knowing when the patient could not name a picture in one language but was aware of its name in the other, and knowing which of the original items were culture-specific and could not be translated (e.g. there is no Italian translation for the word *mug*, and *kettles* are uncommon in Italy). This was a task that a monolingual experimenter would not have been sensitive to. In sum, although the hazard of using translated tests has been mentioned, they were employed here with caution and in the knowledge that using a same test in a second language may not necessarily tap the same processes as in the first. The assessments were conducted primarily for the purposes of exploration in the first instances.

Secondly, the problems concerning patient reports not controlling for spontaneous recovery are a major concern in the literature. In the case of this patient however, this was not an issue since it was possible to obtain an extensive history of clinical problems and treatment from the patient, her GP, her nurses, speech therapists, and from her family. The patient was tested over a year after her stroke, after she had received speech therapy and at a time when her progress remained stable.

Apart from providing an opportunity to assess language attrition in both languages, this patient was of benefit with regards to exploring lexical retrieval, since she had knowledge of a language which utilises grammatical gender - Italian has two genders of masculine and feminine. It is for this purpose that she is reported in this thesis.

The findings of previous chapters have been consistent with the proposed two-stage frameworks (e.g., Butterworth, 1989; Fromkin, 1971; Garrett, 1975; 1980; 1992; Levelt, 1989; Levelt, Roelofs and Meyer, 1999). To re-cap, taking Levelt's model as representative of this class of theories, the first stage of lexical retrieval comprises of conceptual-semantic representations of word meanings called *lemmas.* These contain syntactic information crucial to the successful incorporation of words into sentences, including the grammatical gender of nouns if a language employs it. The second stage of lexical retrieval - the *lexeme* - is where the phonological form of the word is retrieved or assembled (Kempen & Huijbers, 1983). There is evidence for this account from the analysis of speech errors (e.g., Dell & Reich, 1981; Garrett, 1988), tip of the tongue states (Miozzo & Caramazza, 1997; Vigliocco, Antonini, & Garrett, 1997) and experiments investigating object naming latencies (e.g., Jescheniak & Levelt, 1994; Levelt, Schriefers, Vorberg, Meyer, Pechmann, & Havings, 1991). Of concern here, however, are detailed case studies of aphasic patients which have been held to support the two-stage model of lexical retrieval. The fact that the patient in this chapter spoke a language utilising grammatical gender meant that it was possible to carry out a number of tests in Italian only to test further the findings that a noun's grammatical gender is encoded at the lemma and not the lexeme level, with the possibility of replicating past findings, such as those of Henaff Gonon, Bruckert and Michel (1989). These authors reported patient GM who "often indicated spontaneously the gender of sought-after words". However, this capacity seems to have only been tested formally on one occasion when GM was asked to name 36 object pictures and indicate the gender of any he could not name. GM named 19 pictures correctly and gave the correct gender for 13 of the remaining 17 items. ($X^2 = 7.529$ p=.01).

Badecker, Miozzo and Zanuttini (1995) provide a more detailed report of their Italian patient 'Dante' who could reliably report the gender of nouns he was unable to retrieve. Badecker et al. were able to establish that this performance was not mediated by the retrieval of parts of the phonology of target words. In Italian most nouns ending in -o are masculine while most nouns ending in -a are feminine. A patient who could access parts of the phonology of target words might be able to score above chance on gender classification even when the full phonology was not available.

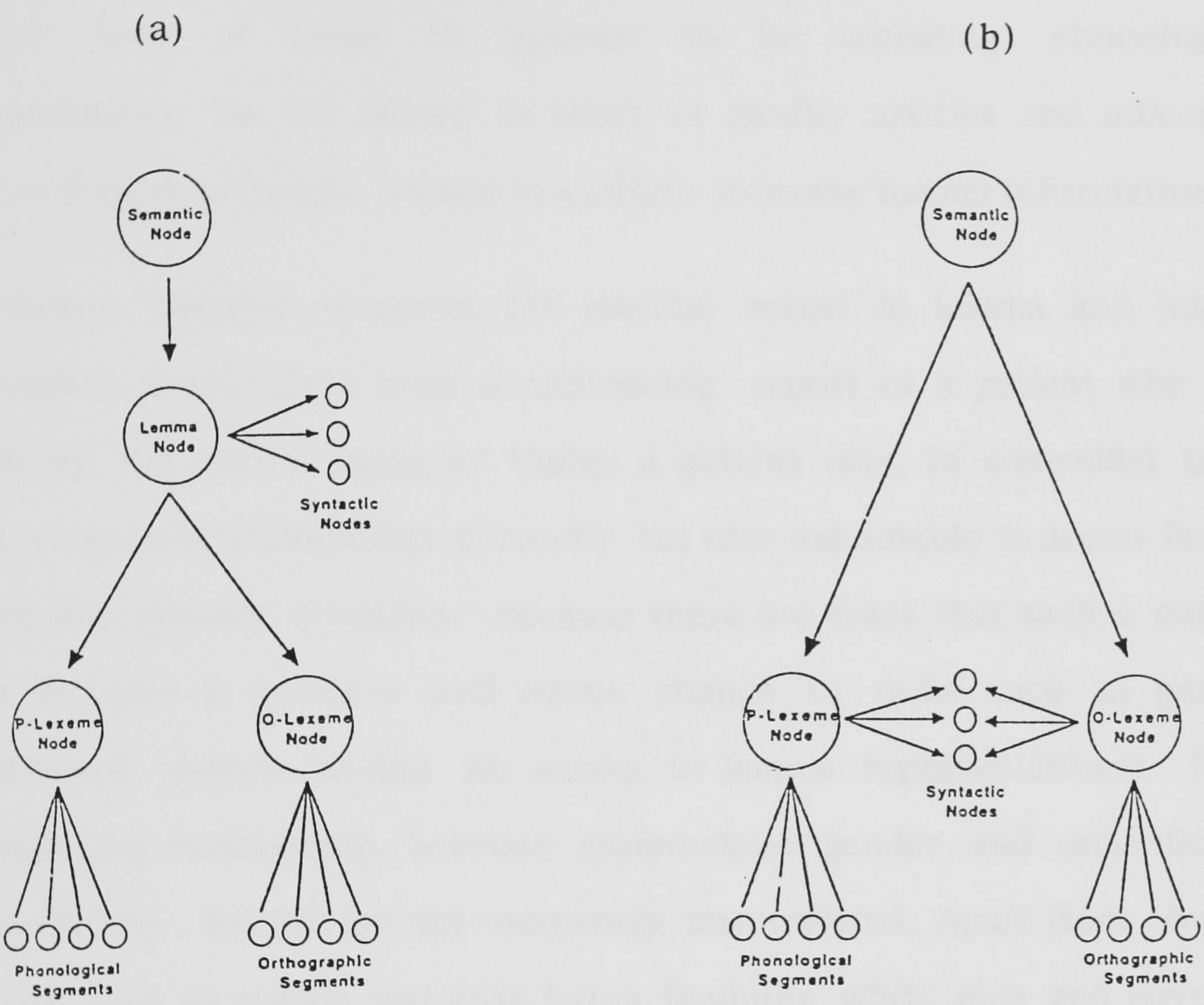
In one study, Dante was required to name 100 pictures and complete 100 sentences of the type *The elephant's tusks are made of* _______ in Italian. When he was unable to retrieve the target word he was asked to indicate its gender, and he was then requested to produce phonological information, which consisted of chosing which of two letters corresponded to the first or last letter, which of two words rhymed with the target word and which of two strings of Xs depicted the length of the target. Dante was able to produce 56% of target words correctly, leaving 88 anomic episodes. He provided the correct gender for 86 of those 88 words (98% correct) but was only at chance level when it came to making judgements on first letter, last letter, rhyme or word length. That is, Dante was able to make accurate gender judgements when he was quite unable to provide any phonological or orthographic information about unavailable words. These are the exact predictions of two-stage models for a patient who can access lemma information but struggles to access lexemes. The same patient was later reported by Miozzo and Caramazza (1997) to be able to indicate whether intransitive verbs he could not retrieve take *avere* (to have) or *essere* (to be) as auxiliaries but Kemmerer (1998) has argued that the choice of auxiliary can be made on the basis of semantic information (verbs describing activities take *avere* while verbs describing states, achievements or accomplishments take *essere*).

Evidence for access to word-specific grammatical (lemma) information in the absence of access to phonological (lexeme) information is predicted by two-stage theories of lexical retrieval, but Caramazza (1997) suggested that this is also compatible with an alternative model, proposing *parallel access* to syntax and phonology. This contrast between two-stage models and Caramazza's (1997) alternative is illustrated in Figure 7.1. According to the two-stage model (Figure 7.1.a), access to lemma information without access to phonology, as shown by patient Dante, could be explained as a consequence of damage after the stage of access to lemmas (e.g. impairment to lexeme representations or access to those representations from the lemmas). However, the parallel access model (Figure 7.1.b) can explain the same pattern of results in terms of impaired access to phonology (lexemes) with preserved access to word-specific grammatical information (lemmas).

However, a crucial difference exists between these models. The parallel access model (Figure 7.1.b) predicts that the reverse dissociation to that seen in Dante should be possible.

Figure 7.1

The Contrast Between Two-Stage Models and Caramazza's (1997) Parallel Access Alternative.



Damage to lemmas (or access to them) in a patient with preserved access to lexemes should result in a patient who can name objects but who does not have reliable access to word-specific grammatical information such as gender. Caramazza (1997) cites spontaneous speech samples from patients reported by Miceli and Caramazza (1988); Cubelli and Perizzi (1996) and Semenza, Mondini and Cappelletti (1995) as evidence that lexeme retrieval may be spared in the presence of impaired lemma access. For example, Miceli and Caramazza's (1998) patient FS once said "Poi io ascolto il televisione...perchè il giornate sono lungo" (Then I listen to the television...because the days are long). This utterance contains three failures of agreement. *Televisione* is a feminine noun so the article should be *la* not *il*, *giornate* (days) is a feminine plural noun so the article should be *le* not *il* and the adjective should be *lunghe* not *lungo* (which is the masculine singular form of *long*). FS appears to be accessing phonological representations, but his failure to select or modify articles and adjectives could, at least in principle, be due to a failure to access lemma information.

Nonetheless, stronger evidence for parallel access to lemma and lexeme information would come from a convincing report of a patient who was effectively the mirror image of Dante: a patient who, in controlled tasks, could access lexical phonology correctly but who was unable to access lemma information reliably ("reliably" because there are ways that such a patient might be able to perform well above chance in tasks such as gender classification despite having no access to lemma representations). First, although the relationship between grammatical gender and semantics is often arbitrary, the two are not completely uncorrelated. Apart from obvious examples such as women and girls being feminine while men and boys are masculine, some other rules for gender exist in Italian, for example, most wild animals have masculine gender while most cities and fruits have feminine gender, whereas names of fruit trees are usually masculine (Duff, 1958). More importantly, perhaps, it would often be possible for a patient with access to lexemes but not lemmas to guess the gender of a noun correctly from its phonology. It has already been noted that in Italian most nouns ending in *-o* are of masculine gender (e.g., *tavolo* [table], *gatto* [cat]): only a few are feminine (e.g., *mano* [hand], *radio* [radio]). In contrast, most nouns ending in *-a* are of feminine gender (e.g., *sedia* [chair], *matita* [pencil]) but a few are masculine. These are often words derived from Greek roots (e.g., *telegramma* (telegram), *dramma* (drama) but there are others (e.g., *cruciverba* [crossword], *dentista* [dentist], *pigiama* [pyjamas]).

A patient showing the pattern predicted by the parallel access model of preserved access to phonology (lexemes) but impaired access to lemmas should tend to misclassify feminine -o nouns as masculine and masculine -a words as feminine. Such a patient would also have great difficulty assigning gender to nouns ending in -e, which may be either masculine (e.g., *leone* [lion], *pedale* [pedal]) or feminine (e.g., *tigre* [tiger], *pulce* [flea]). No literature exists indicating whether either gender predominates, but an initial word count where a page per letter was taken at random from the *Nuovo Zingarelli Minore: Vocabolario della Lingua Italiana* dictionary (Zingarelli, 1987) indicated 597 masculine and 325 feminine words in all, of which there were 73 masculine and 65 feminine -e ending words. Nouns ending in *-u* or *-i* are also ambiguous, but since many of the feminine *-u* ending nouns are marked with a grave accent (*virtù* [virtue], *tribù* [tribe]) but for the sake of simplicity, the tests in this chapter mainly entail the use of the *-e* ending nouns only. The two-stage model would be unable to explain a patient who could not classify by gender exceptional words which he or she could nevertheless name correctly. The discovery of such a patient could provide important evidence in favour of parallel access and against sequential access.

On first appearances, the patient reported in this chapter appears to have difficulty categorising by gender words which she can retrieve and pronounce. However, categorisation by gender is typically performed using 'explicit' or 'off-line' tasks (cf. Tyler, 1992) and the results were different when implicit, on-line tasks were employed to assess access to gender information. Hence, this patient is not described as a case of access to lexeme but not lemma information, but provides cautionary evidence in the usage of aphasic data to test alternative theoretical accounts of lexical retrieval.

7.2. Case History

ED was a right-handed Italian woman who was born in 1925 in San Giuseppe Vesuviano, Naples, Italy. She spent the first 27 years of her life in Italy where she spoke only Italian (and, in particular, the dialect of the Naples area). In 1952, she and her Italian husband moved to England, to Peterborough and then to Bedford, where she worked in the local chocolate factory and had 11 children. Italian remained the language of the home, even though some of her children married English spouses. ED was an active member of the Italian community, participating at events run by the local church and frequently returned to Italy.

In January 1996, ED was hospitalised after developing jaundice. While in hospital she developed signs of aphasia which were confirmed to be due to a CVA involving the left hemisphere. Her CT scans showed a small area of ischaemia in the superior aspect of the left lateral ventricle. There was no hemiplegia. ED received several months of intensive speech therapy in English, and her daughter assisted her in therapy in Italian. After this, her spontaneous speech was relatively fluent. Although she was less confident in English after her stroke, and spoke in Italian whenever possible, she was nevertheless able to converse with friends reasonably well and performed daily living tasks such as shopping. The Cookie Theft picture from the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972) and ED's attempts to describe it in Italian and English may be found in the appendix. Her eyesight had been corrected and she wore her glasses throughout the test sessions. Her hearing was unimpaired. ED was tested between April and December 1997.

This chapter is primarily concerned with ED's naming of objects and her access to information regarding the gender of those object names in Italian, but first, brief summaries of investigations of her visual processing, object recognition and language processing will be presented.

7.3. Visual Processing and Object Recognition

A number of tests were carried out to test ED's visual processing and object recogntion capacites. These were administered in ED's first language, Italian, as they were not carried out to test linguistic proficiency and as she was more confident in this language.

Several tests from the Birmingham Object Recognition Battery (BORB: Riddoch & Humphreys, 1993) were employed to test ED's visual processing. The length matching task requires the participant to decide if pairs of lines of various lengths are the same length or not. The BORB position of gap test consists of pairs of circles of the same size, and the patient is required to decide if the gaps in each of the two circles are in the same position or not; while the size matching test consists of pairs of circles of the same or different sizes. To test object recognition, ED was also given two versions of the 'hard' object decision test from the BORB. This test requires the subject to say whether black-and-white line drawings represent real or unreal objects. The unreal objects are chimerics formed from parts of two different objects. Futhermore, she was also presented with the foreshortened match test from the BORB, which requires the participant to indicate which of two object depicted in a canonical view matches a picture of one of the objects drawn from an unusual (foreshortened) view.

ED was also given the shape detection screening test from the Visual Object and Space Perception Battery (VOSP: Warrington & James, 1991) to test her visual processing. This is a test consisting of twenty stimulus items which are random patterns, on half of which a degraded 'X' is superimposed. ED was required to judge whether the 'X' was present or absent. She was also required to complete the all-picture version of the Pyramids and Palm Trees Test (Howard & Patterson, 1992), a test which requires the participant to indicate which of two pictures "goes with" a third picture presented above them (e.g., indicating that a bow tie rather than a necklace goes with a waistcoat). This test was modified somewhat for an Italian patient, and 13 items - including one practice item - were changed. Alternatives items were selected where the Italian translations were thought to be less familiar to a native Italian (*path* was changed to 'road'), or where the name for that item does not exist as an Italian word (*mug* was changed to 'cup' as no Italian translation exists for that noun). The task was also given to five normal Italian-English bilingual control participants matched to ED on age and number of years in England.

Finally, ED was given the spoken word-to-picture matching test (no. 47) from the Psycholinguistic Assessment of Language Performance in Aphasia battery (PALPA: Kay, Lesser, & Coltheart, 1992). This test requires the patient to indicate which of five pictures on the page correspond to an object name spoken by the tester. The pictures depicted the target object, a closely related object, a more distantly related object, a visually similar object and an unrelated object. The test was administered in English and with an Italian translation of the object names. The test items were divided into two sets. In one session the first set was tested in Italian followed by the second set in English. During a separate session the sets and order of languages were reversed.

ED's results on these tests are shown in Table 7.1. She was impaired relative to controls on all tests except the VOSP shape detection task. This suggests that she may be suffering from visual agnosia. Her errors on the object recognition tasks reflect this, and she often failed to recognise the item depicted by a picture.

Table 7.1.

ED's Performance on Peripheral Visual Processing Object Recognition Tasks.

TASK	ED	Controls	
		mean	range / sd
Peripheral visual processing			
Length match (BORB)	25/30	26.9	22-30 / 1.6
Position of gap (BORB)	28/40	35.1	24-39 / 4.0
Size match (BORB)	23/30	27.3	18-30 / 2.4
Visual object recognition			
Object decision version A (BORB)	16/32	27.0	22-30 / 2.2
Object decision version B (BORB)	20/32	25.4	14-31 / 4.7
Foreshortened match (BORB)	15/25	21.6	16.7-25 / 2.6
Shape detection (VOSP)	19/20	19.75	18-20 / 0.64
Incomplete Letters (VOSP)	14/20	19.40	17-20 / 0.82
Pyramids & Palm Trees Test (all-picture)	21.5/52	49.6	48-51 / 1.14
Spoken word-to-picture matching (PALPA)			
Italian	35/40	39.2	39-40 / 0.45
English	31/40	37.00	36-38 / 1.00

VOSP = Visual Object and Space Perception Battery (Warrington & James, 1991).

BORB = Birmingham Object Recognition Battery (Riddoch & Humphreys, 1993).

7.4. Letter Processing and Reading

ED was given three tests of letter processing. A cross-case letter matching task was given in two versions. In the first, lower-to-upper case version of this task ED was given a sheet on which the 26 letters of the English alphabet were arranged randomly. Italian uses 21 of those letters (it omits *j*, *k*, *w*, *x* and *y*). ED was presented with lower case letters one at a time and was required to point to the corresponding upper case letter. The second, upper-to-lower case version was the same except that she matched single upper case letters to an array of lower case letters. The task was also given to five anglo-Italian, bilingual control participants, comprising of three females and two males. These were matched to ED on age (mean age = 74.2 years, range = 72-76 years) and on time spent in the UK (mean time spent = 44.2 years, range = 43-45 years).

The second task comprised of all 26 letters in upper or, on a separate occasion, lower case and ED was required to point to the letter corresponding to the one she heard in Italian. Again, the task was also given to the five Anglo-Italian controls. The third letter processing task was the incomplete letters test from the VOSP battery which requires the subject to identify fragmented letter forms. ED did this by naming the letters in Italian. Some of the letters in this task - *k*, *x*, *y* and *w* - are not in the Italian alphabet, but have Italian names, which ED was required to produce.

In addition to these tasks, ED was also presented with a list of 50 words of three syllables to read aloud. All were high frequency Italian words. Half the words carried stress on the penultimate syllable, which is the stress pattern of about 70% of Italian words (Rozzini, Bianchetti, Lussignoli, Cappa, & Trabucchi, 1997). The remainder were a mixture of words with a first-syllable stress and words with the antepenultimate stress. Job, Sartori, Masterson and Coltheart (1984), Miceli and Caramazza (1993) and Rozzini et al. (1997) have suggested that misassignment of stress in reading aloud may characterise Italian surface dyslexics who utilise sublexical letter-sound correspondences rather than identifying and pronouncing words as whole units. The words were presented to ED and the five controls in a random order for reading aloud.

The results of these tasks are shown in Table 7.2. Of the letter processing tests, ED was outside the normal range on all but the Italian upper case spoken to written letter matching, though letters which attracted the greatest number of errors were those used in English but not Italian (*j*, *k*, *w*, *x* and *y*). In reading aloud ED read 23/25 words with regular (penultimate syllable) stress assignment correctly compared with 19/25 of the words with irregular stress. Five of her 6 errors made on irregularly-stressed words were those of stress missassignment, whereas the rest of her errors were of a visual nature.

It is necessary to remember here that ED was likely to hear and speak more Italian than she read and wrote despite being bilingual and an active Italian speaker. However, this situation was the same for the age-matched controls as they were from very similar backgrounds as ED. Given that the controls scored an average of 48.2/50 on the same task, ED's errors occurred as a result of her impairment rather than because she read less Italian than she spoke.

Table 7.2.

ED's Performance on Letter Processing and Reading Tasks

TASK	ED	Controls	
		mean	range / sd
English cross-case matching of letters	17/26	23.4	23-25 / 0.89
Italian cross-case matching of letters	18/21	20.4	20-21 / 0.55
Incomplete Letters (VOSP)	14/20	19.4	17-20
English Spoken to written letter matching			
UPPER CASE	17/26	20.2	19-22 / 1.30
lower case	16/26	22.0	21-24 / 1.22
Italian Spoken to written letter matching			
UPPER CASE	19/21	21	19-22 / 1.30
lower case	18/21	20.2	21-24 / 1.22
Pyramids & Palm Trees Test (all-words)	36/52	50.6	50-51 / 0.55
Reading aloud	42/50	48.2	46-50 / 1.48

7.5. Naming and Explicit Gender Categorisation

ED was presented with 110 line drawings from the Snodgrass and Vanderwart (1980) and from the Morrison, Chappell and Ellis (1997) set. Previous screening with 18 younger Italian-English bilinguals had established that these items all had high name agreement in both English and Italian. That is, at least 16 of the 18 bilinguals had named them correctly in both languages. Fifty-three of the object had names that were of masculine gender. Of these, 31 had consistent *-o* endings, 1 item (*occhiali* [glasses]) had a consistent plural *-i* ending, 2 had consistent consonant endings, 1 item (*dentista* [dentist; *masculine*]) had an exceptional *-a* ending, which was also ambiguous (a female *dentista* is feminine whilst a male is masculine) and 18 had ambiguous *-e* endings. The remaining 57 were of feminine gender. Fifty-three had regular *-a* endings while 4 had ambiguous *-e* endings. The pictures were presented to ED over two sessions.

In the first session, ED was instructed to name half the objects in Italian followed by the other half in English. In a second session, she named the sets in the other language (English first then Italian). When ED was presented with the pictures for naming in Italian, she was also asked to indicate the gender of each object's name immediately after attempting to name it. She did this whether or not she had named the item correctly and made her response by pointing to one of two cards labelled *maschile* ('masculine') and *femminile* ('feminine').

ED named 64 pictures correctly in Italian and 56 in English, as shown in Table 7.3. This difference is in the direction one might expect for a patient for whom English was a second language, but the difference was not significant (McNemar $X^2 = 0.51$, df = 1, $p = .0843$). She made 10 purely visual naming errors in both English and Italian (e.g., English: *pen* for cigar; *bag* for envelope; Italian: *cappello* [hat] for torta/cake; *borsetta* [little bag] for pane/bread). She made a further 15 English and 13 Italian errors in which the target and response were both visually and semantically similar (e.g., English: *lorry* for bus; *dress* for skirt; Italian: *casa* [house] for chiesa/church; *cavallo* [horse] for donkey/asino)· Other errors included those where a diminutive name or dialect name was given (e.g., Italian: *busso* for autobus [bus], *bilanza* for bilancia [scales]), phonological errors: (e.g., English: *rawsberry* for strawberry, Italian: *fischio* for fischietto [whistle]). In a separate session ED repeated all 110 object names correctly in both

Italian and English.

Table 7.3.

Relationship Between ED's Naming in English and Italian for 110 Object Pictures.

		English		
		Correct	Incorrect	Total
Italian	Correct	47	17	64
	Incorrect	9	37	46
	Total	56	54	110

With regards to ED's gender categorisation in Italian, Table 7.4 shows the relationship between her naming and gender assignment, and Table 7.5 shows the number of correct responses made to different classes of words. For the masculine nouns, ED named significantly more consistent -o ending nouns correctly than masculine ambiguous -e ending ones (18/31 vs. 6/18: $\chi^2 = 66.41$, df = 1, $p < .01$). In total, she named 64 objects correctly and assigned the correct gender to 66 objects.

These figures are in no way comparable, however, because the gender classification task has a 50% chance rate whereas the probability of naming an object correctly by chance is miniscule. Sixty-six correct gender classification responses represents a 60% correct response rate which, for this number of items, is not significantly better than chance (Fisher exact = 0.6). A somewhat different picture emerges, however, of gender classification of objects named correctly or incorrectly is considered. ED correctly classified 46/64 (.72) objects that she named correctly (Fisher exact, = 0.719) compared with 20/46 (.43) objects that she named incorrectly (Fisher exact = 0.565).

However, if we consider the data the other way to see if ED's naming accuracy was dependent on correct gender classification, an interesting picture emerges. Of the 64 items (.70) that ED named correctly, 44 were items she then classified correctly for gender, but she managed to name correctly 18/44 items (.28) which she immediately misclassified for gender.

Table 7.4.
Relationship Between ED's Italian Naming and Gender Classification for 110 Object Pictures.

		Naming		
		Correct	Incorrect	Total
Gender classification	Correct	46	20	66
	Incorrect	18	26	44
	Total	64	46	110

Table 7.5
Number of Correct Responses to Different Classes of Word in the Gender Categorisation Task.

Word type	Number correct	Proportion correct
Masculine		
Consistent -o ending	18/31	.58
Consistent plural -i ending	0/1	0.00
Consistent consonant ending	2/2	1.00
Exception -a ending	0/1	0.00
Ambiguous -e endings	6/18	.33
Feminine		
Regular -a endings	37/53	.70
Ambiguous -e endings	3/4	.75

7.6. What Exactly Predicts ED's Naming?

Given that gender categorisation has a 50% chance rate (each item is either *masculine* or *feminine*), ED's score of 66/110 (60%) was considered too close to chance for analyses to be conducted into the factors predicting her classification scores. On the other hand, it was possible to analyse her *naming* scores.

ED's scores on picture naming in Italian were entered into logisitic multiple regression analyses, employing the variables of: visual complexity, familiarity, imageability, age of acquisition, frequency, name agreement and length. A correlation matrix is shown in Table 7.6, and Table 7.7 shows the results of the analysis for Italian picture naming. The results are reported using rated frequency and syllable length, but they were the same when the analyses were repeated using written frequency from Bortolini, Tagliavini and Zampolli (1971) and length measured in phonemes. The only variable to significantly exert effects on ED's picture naming was imageability.

Table 7.7.

Results of Logistic Multiple Regression Analysis of ED's Italian Picture Naming Accuracy (n=110).

	ß Coeff.	Std. Error	Wald	R
Visual Complexity	-0.29	0.30	0.88	0.00
Familiarity	-0.15	0.31	0.24	0.00
Imageability	5.94	2.25	0.70**	0.18
Age of Acquisition	-0.63	0.55	1.27	0.00
Rated Frequency	0.18	0.46	0.16	0.00
Name Agreement	0.18	1.77	0.01	0.00
Syllables	0.01	0.23	0.00	0.00

* $p < .05$ ** $p < .001$

Table 7.8

Correlations Between ED's English Picture Naming Accuracy and the Predictor Variables (n = 110).

	1	2	3	4	5	6	7	8	9	10	11
1. ED's English Picture Naming Accuracy	1.00	-.010	.196*	.429**	-.231*	-.325**	.209*	.149	-.009	-.100	-.159
2. Visual complexity		1.00	-.403**	-.100	.093	-.005	-.341**	-.166	-.256**	.093	.158
3. Familiarity			1.00	.397**	-.421**	-.355**	.837**	.433**	.009	-.178	-.205*
4. Imageability				1.00	-.421**	-.399**	.394**	.272**	-.120	-.118	-.203*
5. Rated Age of acquisition					1.00	.794**	-.570**	-.531**	-.022	.441**	.500**
6. Objective Age of acquisition						1.00	-.434**	-.372**	-.037	.247**	.305**
7. Rated Frequency							1.00	.571**	.003	-.296**	-.326**
8. Celex Combined Frequency								1.00	.137	-.454**	-.469**
9. Name Agreement									1.00	-.098	-.064
10. Number of syllables										1.00	.871**
11. Number of phonemes											1.00

* $p < .05$ ** $p < .01$

The analyses were repeated using ED's scores for *English* picture naming. The variables included in the logistic regression analyses were the same as before: visual complexity, familiarity, imageability, age of acquisition, frequency, name agreement and length. Again, a correlation matrix is shown in Table 7.8, and Table 7.9 shows the results of the analyses for Italian picture naming. The results were highly consistent with the results of ED's Italian naming, with only imageability exerting effects. There were no effects of any of the other variables. Table 7.9 reports the results of the logistic regression analysis when rated AoA, rated frequency and phoneme length were the variables employed, but the results were highly consistent when the analyses were re-run using a combination involving objective AoA, Celex combined frequency and syllable length.

Table 7.9.

Results of Logistic Multiple Regression Analysis of ED's English Picture Naming Accuracy (n=110).

	ß Coeff.	Std. Error	Wald	R
Visual Complexity	0.28	0.33	0.74	0.00
Familiarity	0.07	0.33	0.05	0.00
Imageability	7.99	2.32	11.83**	0.25
Rated Age of Acquisition	0.01	0.46	0.00	0.00
Rated Frequency	0.43	0.51	0.01	0.00
Name Agreement	1.47	2.49	0.35	0.00
Phonemes	-0.12	0.17	0.52	0.00

* $p < .05$ ** $p < .001$

7.7. Gender Sorting

On a separate occasion, ED was given the 110 pictures again. She was specifically instructed *not* to name them, instead, to place each picture on

7.7. Gender Sorting

On a separate occasion, ED was given the 110 pictures again. She was specifically instructed *not* to name them, instead, to place each picture on one of two piles labelled masculine and feminine. ED scored 87/110 (.80) compared with 66/110 in the name-then-categorise task, which is significant (McNemar $X^2 = 13.47$, df = 1 $p = .01$). A breakdown of gender of objects, their endings and ED's scores is in Table 7.10. ED made few errors on words with the consistent masculine -*o* ending or the regular feminine -*a* ending. She made a substantial number of errors, though, on masculine words with ambiguous -*e* endings. In fact, her performance on those items was not significantly better than chance (11/18 correct), which suggests that she may have been naming and then classifying some of the pictures.

7.8. Silent Gender Decision

In the previous experiment ED had particular difficulty classifying words with -*e* endings, even though almost all of these were masculine. To explore this further a task was constructed in which ED was required to decide the gender of -*e* ending nouns. There were 34 words in the set, of which half were masculine and half were feminine. The words were randomly intermixed with 17 regular feminine -*a* words, 17 regular masculine -*o* words, 2 exceptional -*a* words and 7 exceptional -*o* words. The words were read aloud to ED who was required to say if each noun was *femminile* (feminine) or *maschile* (masculine). Fifteen practice items were included.

The results of this task are shown in Table 7.11. Overall ED classified 51/77 words correctly (.66). This is significantly above chance (Fisher exact = 0.660) but is clearly very impaired (5 bilingual controls classified an average

Table 7.10.

Number of Correct Responses to Different Classes of Word in the Gender Sorting Task.

Word type	Number correct	Proportion correct
Masculine		
Consistent -o ending	24/31	.77
Consistent plural -i ending	1/1	1.00
Consistent consonant ending	2/2	1.00
Exception -a ending	0/1	0.00
Ambiguous -e endings	11/18	.61
Feminine		
Regular -a endings	46/53	.87
Ambiguous -e endings	3/4	.75

of 74/77 words correctly [71-76]). ED performed reasonably well on the regular feminine -a words and the regular masculine -*o* words but she made 4 errors on the exceptional feminine -*o* words. On the -*e* ending words she had a tendency to classify them as feminine, resulting in 15/17 correct responses to the feminine items but 12/17 errors on the masculine items. This difference is significant ($\chi^2 = 71.70$, df = 1, $p < .01$). Controls classified an average of 32.6/34 of the -*e* ending words correctly (range 31 - 34).

In sum, ED has problems in gender classification. She knows that words ending in -*a* are mostly feminine and that words ending in -*o* are mostly masculine, but she makes a substantial number of errors when classifying exception words or words with the ambiguous -*e* ending.

In the name-then-classify task she named correctly 18 of the 44 items she misclassified for gender. That could be taken as evidence for parallel access to lemma and lexeme information. The gender classification tasks used thus far have, however, employed tasks which require the patient to make the kind of explicit, meta-linguistic judgements that Tyler (1992) refers to as "off-line". Tyler argues that it is better to use tasks in which knowledge is employed in a more automatic, "on-line" fashion; tasks which reveal the presence of different forms of linguistic knowledge through their influence on language performance which is as natural and automatic as possible.

Table 7.11.

ED's Results on the Silent Gender Classification Task

Word type	Number correct	Proportion correct
-e ending words		
masculine	5/17	.29
feminine	15/17	.88
-a ending words		
feminine (regular)	13/17	.76
masculine (exception)	2/2	1.00
-o ending words		
masculine (regular)	14/17	.82
feminine (exception)	3/7	.43

A third and final gender task was designed to involve more implicit, on-line use of gender through adjective-noun agreements. In Italian, gender must be marked on all of a noun's modifiers (articles, determiners and adjectives) as well as on all pronouns. As far as adjective-noun pairs are concerned, most adjectives are adapted to the gender of the noun they modify, ending in *-o* for masculine nouns (e.g., *il piatto piccolo* [the small plate]) and *-a* for feminine nouns (e.g., *la bottiglia piccola* [the small bottle]) - Italian typically places the adjective aften the noun, whereas in English the adjective precedes the noun.

For exceptional masculine -a ending nouns the adjective will still take the masculine *-o* form (e.g., *il fantasma pauroso* [the scary ghost]) while for exceptional feminine *-o* ending nouns it will take the feminine *-a* form (e.g., *la mano sporca* [the dirty hand]). Similarly adjectives modifying masculine -e ending nouns take the *-o* form (e.g., *il ponte piccolo* [the small bridge]) while adjectives modifying feminine *-e* ending nouns take the *-a* form (e.g., *la volpe piccola* [the small fox]). Some adjectives, such as *grande* ('big') end in *-e* and these do not change for singular nouns of either gender: *il piatto grande* or *la bottiglia grande*, but these do change from *-e* to *-i* endings for plural nouns: *i piatti grandi* or *le bottiglie grandi.*

For this task, the fact that ED was bilingual was exploited. She was presented with adjective-noun pairs in English and was asked to translate them into Italian. For example, she was asked, "*In Inglese si dice 'fresh bread'. Come si dice in Italiano?*" ("In English we say 'fresh bread'. How do we say this in Italian?"). Some of the nouns in this task were the same set that were used in the explicit gender sorting task. Each was paired with an adjective which changed from *-o* ending to *-a* ending according to the gender of the noun. The results are shown in Table 7.12. ED used the version of the adjectives that matched the gender of the noun on 67/77 trials. This compares with correct explicit classification of 51/77 items in the gender sorting task (McNemar X^2 = 17.21, df = 1 p =.01).

Of particular note is the fact that whereas ED only classified 5/17 masculine *-e* ending words correctly in the gender sorting task she give the correct masculine *-o* ending to 16/17 items in the implicit, on-line translation task. The ten errors she made in the translation task were of a translation type, that is, they were instances where she did not know the adjective or the noun's name in English (rather than misclassification of gender). Again the difference between ED's classification of masculine and feminine -e ending nouns is significant (16/17 vs. 13/17: χ^2 = 12.70, df = 1, $p < .01$). Here, she is showing a tendency to be better at retrieving the masculine than the feminine nouns, whereas for the other tests on the -e ending nouns she was significantly better at the feminine than the masculine ones (.75 vs. .33 on gender categorisation and 15/17 vs. 12/17 on silent gender classification). The five control participants from before scored and average of 74/77 on this task (range =71-76).

Discussion

ED's performance of 37.5% on the all-picture version of the Pyramids and Palm Trees Test may be indicative of a mildly impaired semantic system, but her normal-range performance of 95% on the all-word version of the Pyramids and Palm Trees Test confirms this to be as a result of task demands. Her poor performance reflects her visual problems. This low score, along

Table 7.12.

Number of Adjective-Noun Pairs Showing Correct Modification of the Adjective in Accordance with the Gender of the Noun.

Word type	Number correct	Proportion correct
-e ending words		
masculine	16/17	.94
feminine	13/17	.76
-a ending words		
masculine (exception)	2/2	1.00
feminine (regular)	14/17	.82
-o ending words		
masculine (regular)	16/17	.94
feminine (exception)	6/7	.87

with her description of the Cookie Theft picture illustrate the probability that ED is mildly agnosic. Also reflecting a degree of visual agnosia, most of the errors that ED made in naming in either language were of a visual type (such as naming a cigar a "pen" and an envelope a "bag") or visual-and-semantic type (such as naming a bus a "lorry" and a skirt a "dress".

Further evidence of ED's visual problems may be seen in the results of her picture naming. When ED's scores on picture naming in English or Italian were entered into logisitic multiple regression analyses, the only variable to significantly exert effects on ED's picture naming was imageability, with no effects of any of the other variables of visual complexity, familiarity, imageability, age of acquisition, frequency, name agreement and length. This is in line with past findings. Effects of imageability have been found in studies of aphasic picture naming (Nickels, 1995; Nickels & Howard, 1995), in aphasic comprehension tasks (Franklin, 1989), in developmental phonological dyslexia (Howard & Best, 1996) and have been well documented in reading aloud in deep dyslexics (Richardson, 1975; Coltheart, Patterson & Marshall, 1980).

The finding of an imageability effect in ED's naming is also consistent with findings by Best (1996) whose aphasic patient MF showed to have naming accuracy affected by length and by imageability, but not by frequency or age of acquisition. Marcel and Patterson (1978) found that some of their aphasic patients were showing imageability effects in visual word recognition, and concluded the effect to be semantic in nature. One way to explain ED's imageability effect and the fact she makes visual, semantic, and visual-and-semantic errors, is to invoke imageability as a mental process (Richardson, 1975). ED is able to construct an appropriate mental image directly from her perception of a line drawing, and she then responds by naming (or giving the gender) to the item imaged. This raises the concern that ED's apparent problems on explicit tasks might be due to the visual object recognition with pictures. In other words, it may be that ED could not classify the pictures by gender because she could not see them.

In the case that ED is making errors because of her visual problems, her performance on the written or verbal tasks must be considered. ED scored 66/110 (.60) on gender on the name-then-categorise task, 87/110 (.79) on the gender sort task, 51/77 (.66) on the silent gender task and 67/77 (.87) on the implicit adjective-noun translation task. Given her comparatively high performance on the gender sort task - which did involve picture recognition - and on the more implicit tasks, this possibility may be dismissed. However, further testing might have involved explicit gender tasks which did not involve pictures, such as reading aloud or article-to-noun tasks employing nouns with opaque endings.

On the whole, ED's naming performance was better in Italian than it was in English, which is not surprising given that Italian was her only language for the first twenty-seven years of her life, and her more frequently used language later on in life after she had retired and her children had left home. More dialect errors were made in Italian, which probably reflects the type of Italian spoken in immigrant populations of the sort ED was from, but could also reflect either the fact that Italian dialects are more removed from 'standard' Italian than English dialects are from 'standard' English, or that ED had not mastered English to a sufficient level to acquire a dialect. In analysing linguistic behaviour of Italians in Bedford, Tosi (1984) suggests that the borrowings occur to replace items with different names in different dialects, demonstrating the insufficiency of the Italian immigrant's vocabulary for expression in different surroundings. This is certainly detectable in some of ED's spontaneous speech, but her blended and 'other language' errors do show some semantic problems: as shown in her misnaming a picture of a *ring* as *pendant*, for example, or *tent* as *flag*, or even *book* as *refrigerator*. In most of these cases, the responses she gave were later acquired than the targets.

There are several points to note in terms of grammatical gender and the implicit/explicit distinction in testing. From the evidence on the *explicit* gender tasks, it appears that ED does have an impairment in lemma retrieval in the (main) absence of phonological problems. There are times when she produces an incorrect gender to a correct name, which would suggest that she is performing in accordance with Caramazza's arrangement. This manifests itself on the phonologically opaque, ambiguous *-e* endings especially. ED's high error rate on the ambiguous-*e* endings is consistent with Bates et al.'s (1995) finding that Italian adults made more errors on *-e* ending nouns (particularly the feminine ones) in word repetition and gender monitoring. There were fewer feminine-*e* ending items in the parts of this study involving picture naming, since feminine-*e* ending nouns are typically abstract words, many are those nouns which end in*-zione* (the English equivalent is '-tion').

In explicit gender categorisation, ED was simply employing incorrect strategies to decide if an object was masculine or feminine. In gender classification both with and without naming, she often decided an item's gender by *association.* For example, 'dress' - *il vestito* (masculine singular) is an item with typically feminine associations, to which she assigned a feminine gender. Similarly, 'motorbike' - *la motocicletta* (feminine singular), instead, is an item with typically masculine associations, and ED assigned it a masculine gender. This *even* occurred when she was made aware of the noun's article (whether it took *il, lo, la,* etc.). If it were the case that she were employing incorrect strategies for all these explicit gender decisions, however, she would show this for *all* items with strong associations. She still managed to correctly classify some items with associations such as 'shoe' (*la scarpa,* feminine, even though a man's shoe is depicted in the stimulus picture).

It was fortunate that ED's bilingualism allowed for the opportunity for *implicit* gender categorisation, for it is apparent from the implicit tests that her knowledge of gender was actually better preserved than the explicit tasks implied. As Tyler (1992) notes, it is somewhat surprising that research into aphasia relies almost exclusively on data from off-line tasks. All that off-line data can tell us is about those aspect of representations of which the patient is aware and can explicitly reflect on, they tell us little or nothing of the representations of which the patient is *unaware*. This has important implications for the conclusions we would have drawn from ED's performance. Had inferences been made on ED's gender access solely from the explicit gender classification tasks, the conclusions would have been different, and it would have seemed that her gender retrieval was impaired whilst her phonological access remained intact. Instead, she has demonstrated less difficulty in *implicit* gender retrieval.

According to Tyler, one advantage of using on-line (implicit) tasks is that they tap the automatic processing involved in language comprehension. As a result of this, on-line tasks should not be affected by strategies - at least not those under voluntary control. A patient suffering from a language impairment will compensate for that impairment by employing a compensatory strategy, and as a result, his/her performance is better than it should have been as a result of the impairment alone. One example of this is the strategy that ED was employing of classifying pictures by their associative (semantic) gender. In some instances, ED's strategy was not a good one, because the item's semantic gender did not correspond to its grammatical gender (e.g. *la cravatta (the tie)* is masculine in associative but feminine in grammatical gender). Nonetheless, this strategy did aid her performance on many items, and ED was not able to use this same strategy in the on-line (implicit) tasks.

Tyler also examines the possible patterns of performance in patients when on-line and off-line tests are used. Poor on-line and good off-line performance (the opposite of ED) should be a rare occurrence, apart from cases where a linguistic process is operational but slowed down. In this case, on-line processes and representations as measured, for example, by word-monitoring, would be impaired, whereas off-line performance would be good. Poor performance on both on-line and off-line testing would be apparent in a patient whose underlying deficit is extensive. Lastly, a patient showing poor off-line but good on-line performance is one such as ED. ED's comprehension and ability to provide grammatically correct sentences in terms of grammatical gender was unimpaired. However, in tests which required her to make an explicit response, she performed poorly. This dissociation suggests that a distinction may be made between processes and representations of which a speaker can and cannot be aware. The reason for ED having problems in the explicit but not implicit tasks is because she is not aware of the process she is using to perform correct gender classification.

To conclude, if we are to take the two-stage models of lexical processing as a starting point, ED appeared, at first glance, to be behaving in a manner that contradicted the two-stage modularity of frameworks such as that of Levelt. She appeared to show impaired retrieval of grammatical gender in the absence of impaired naming for some object names. Initial testing appeared to show that she was behaving as Caramazza's model predicts, showing parallel access to lemmas and lexemes. However, further testing showed that she was not as impaired on grammatical gender as initially demonstrated. Although implicit testing did not rule the possibility that she was behaving in accordance with Caramazza's framework, as yet, no reports have been made of patients showing impaired access to the lemma but intact access to the lexeme pathway, even though cases showing the opposite are in existence. Of major importance, then, is not whether this patient was behaving more in the manner of one model or the other, rather, the issue that explicit tasks may be misleading as a means of assessing gender knowledge in aphasia.

Chapter 8

Conclusions & Overview

8.1. The Rôle of this Thesis

The purpose of this thesis was to explore lexical processing as it occurs in speakers of monolingual or bilingual Italian and English. The purposes of investigating these two languages in particular are twofold. On a very base but practical level was the fact that populations of Italian native and English native speakers were available, and perhaps most importantly, so were homogenous groups of English-Italian and Italian-English bilinguals, and a bilingual experimenter. There is little point in studying a bilingual population if it is not a representative group. An English-Italian population provided a fruitful base for experiments, given that age- and language-matched control subjects would be available, and that the experimenter was sensitive to certain linguistic subtleties manifested by the participants. One of limitations of this thesis has been in obtaining data from the converse of the populations, i.e., English-Italian and Italian-English bilinguals *in Italy* . This is one suggestion for future research.

Secondly, and most importantly, the nature of the Italian language compared to the English language provided a useful basis for data acquisition. Not only does Italian have a shallow orthography which allowed to a small degree for some exploration into the topic of depth of orthography, but there was also enough linguistic closeness between the two languages to be able to manipulate object names in terms of cognateness. English and Italian are similar enough to have words that originate from the same root, allowing for stimuli to be manipulated by whether they are cognates or not; but are dissimilar enough to have enough words originating from separate roots, allowing for non-cognate stimuli to be generated. In addition, Italian has grammatical gender, which rendered possible the exploration of pre-phonological mechanisms, a long-standing problem for experimenting in English.

The thesis has comprised three sections, in the hope that each one would provide a focused study on each important aspect. First of all, it was necessary to examine existing monolingual studies in both languages. The first three chapters explored monolingual processing with regards to picture and word naming and, for Italian, gender retrieval. The fourth and fifth chapter comprised of a second section which examined bilingual processing, and lastly two chapters were devoted to the cognitive neuropsychology of bilingualism, reporting a bilingual patient with word-finding problems and, given that the patient's first language was Italian, the breakdown of grammatical gender and the importance of implicit testing.

8.2. Organisation of Lexical Processing in English and Italian Monolinguals

There are many studies in existence examining factors affecting English picture naming and word reading. Chapter 1 described how factors studied in English picture naming are visual complexity, familiarity, frequency, age of acquisition, name agreement and length, and factors implicated in English word naming are length, frequency, age of acquisition and orthographic neighbourhoods. Fewer studies exist in Italian (although some studies do exist in French, Spanish and Dutch). This thesis has reported a number of studies examining these effects.

Experiments 1 - 4 reported in Chapter 2 sought to provide a starting ground for exploring lexical organisation in speakers of English and Italian by using monolingual native speakers of each in experiments involving the naming of pictures and words. For English picture naming, past findings were replicated in that effects of age of acquisition and marginal effects of familiarity were found, whilst for Italian picture naming there were effects of age of acquisition and name agreement. For word naming in English the strongest effects were exerted by age of acquisition, but there were also effects of frequency, length and orthographic neighbourhoods. Italian word naming found effects of age of acquisition, length and frequency. One of the most important findings of these experiments was the finding of age of acquisition effects both across tasks and across languages, which suggests that the effect is not modality specific, and is also universal.

The findings were applied to current models of lexical processing, by interpreting familiarity effects in English picture naming as occurring after the first stage of picture naming, which entails identifying an object and recognising it as being familiar. As the effects of orthographic neighbours and letter length were confined to certain analyses only, it was reasoned that the marginal effects of these variables were occurring because of statistical artefacts due to colinearity (although their emergence as significant still replicates past findings, e.g. Andrews, 1989). In Italian picture naming, it was supposed that name agreement effects arose because more Italian items had a name agreement at 90% or less than English items, and also because most Italian participants would have been likely to have had more than one name to each of the items as a result of dialect or diminutive names. Lastly, the consistent effects of age of acquisition occur in terms of words which are acquired earlier in life being faster to access and to be produced than later acquired ones.

Longer reaction times by Italian participants may be accounted for in terms of Levelt's (1989; 1999) model. Grammatical information is encoded in the *lemma* level, which not only includes syntax but, for Italian speakers, grammatical gender. For picture naming a noun's gender would have to be retrieved in order for the correct article and adjective endings to be chosen. It is likely that increased reaction times by Italian speakers may be due to the representation of lemma information, and as a result of processes subsequent to lemma retrieval. For word naming, where the word is presented in its entirety, gender retrieval is less important and may be ascertained from a noun's ending. This explains why the difference between word naming RTs for English and Italian was smaller than the difference between English and Italian picture naming.

A two-way analysis of variance on a core set of items which had featured in all four experiments found effects of task and language, with picture naming taking longer to perform and Italians showing lengthened reaction times. An interaction was found and a test of simple main effects found the interaction to arise from the fact that Italian participants were slower than English participants to perform on picture naming but not word naming. It was reasoned that this occurs because when a speaker of Italian accesses a noun (picture name, in the case of this experiment), (s)he will also access its gender and appropriate definite and indefinite article and other lexical information to ensure that the noun agrees with other words in a sentence.

In a further investigation into longer reaction times for Italian participants, Experiment 5 provided evidence that the difference in reaction times between English and Italian participants was not occurring at the visual level. There was no difference in the reaction times of English and Italian native speakers in discriminating between squares and triangles. Similarly, Experiment 6 showed that the difference was not due to semantic access - there was no significant difference between English and Italian speakers' reaction times in discriminating between pictures of living and non-living entities.

8.3. Organisation of Italian Lexical Processing and Grammatical Gender

Grammatical gender is a useful tool for exploration of the lexicon. The English language does not have gender, which has resulted in something of a lack of studies exploring the difference between early syntactic and later phonological retrieval in object naming. If one is to believe that grammatical gender is stored at a syntactic level, then the variables affecting gender retrieval will differ to those affecting word-form (phonological) retrieval. Similarly, this issue is examined from a different perspective, the emergence of a variable as significant for a gender retrieval task but its absence from a phonological retrieval task would provide an apparent locus for where that variable would be exerting effects.

Experiments 7 and 8 examined lexical access in Italian native speakers only, with regards to grammatical gender employing both multiple regression and factorial designs. Experiment 7 entailed Italian participants classifying black and white pictures in terms of whether they depicted objects with a name of a masculine or feminine gender. Multiple regression analyses employing the variables of visual complexity, grammatical gender, gender transparency, gender agreement, name agreement, age of acquisition, frequency and length showed that grammatical gender made a significant independent contribution to predicting gender categorisation reaction time, reflecting the fact that categorisation times were faster to objects with feminine names (mean 877 ms) than to objects with masculine names (mean 944 ms). There were also significant effects of gender agreement and name agreement, with faster reaction times being associated with high levels of agreement in both cases, but no effects of visual complexity, gender transparency, age of acquisition, word frequency and word length.

When multiple regression analyses were carried out for this same subset of items using the picture naming RTs obtained from the Italian participants in Chapter 2, the results were consistent, with name agreement and age of acquisition exerting the strongest effects and with marginal effects of gender agreement. The fact that the results for gender classification were consistent in terms of name agreement but not for age of acquisition (i.e., AoA exerted effects in picture naming but not in gender classification) suggests an apparent locus for the effects of AoA. In fact, the factorial experiment (Experiment 8) went on to prove that the locus of AoA is at the lexeme and not the lemma level in Levelt's (1999, Levelt, Roelofs & Meyer) model. Participants were required to classify by gender and name early and late acquired masculine and feminine object pictures. For gender classification, a task tapping the lemma stage, there were no effects of AoA. For picture naming of the same items (by the same participants) however, age of acquisition effects were found. These results were replicated in by subjects and by items analyses, as well as for the errors.

8.4. Organisation of Lexical Processing in English-Italian Bilinguals

By Chapter 4 the issue of monolingual lexical retrieval was laid to rest, whilst the topic of bilingualism was explored. Theoretically, the area is not a new one, and dates back as far as Cattell's first (1887) studies, but experimentally the area has been somewhat neglected, granted the demands it makes on having a homogenous population of bilinguals to hand. Fortunately, populations of this nature do exist in the UK and it was possible to employ an English-Italian community for this purpose.

The results of Chapter 5 were somewhat unexpected, in that it was found that bilinguals showed lengthened reaction times in picture naming. This seems a strong and somewhat non-politically correct conclusion to reach, but it was by no means the first mention of the finding. Cattell had suspected that learning a second language might interfere with the speed of association between concepts and words in the first language, and Mägiste (1981) had previously implied that trilingual participants operated slower than bilingual participants who operated slower than monolingual participants. The findings of Experiment 9 confirmed this, with bilingual participants taking, on average, 218 ms longer to name pictures than monolingual participants. It was hypothesised that there could be two reasons for this. First, this occurrence in the bilinguals could have been due to the words in the lexicon of a bilingual being activated half as frequently as for those of a monolingual (but their concepts being activated the same amount of times). In this case, it would have been possible to have seen bilinguals acting like monolinguals at tasks involving a concept (i.e. pre-semantic) level but with lengthened RTs occurring at the lexical levels. Hence, it would have been possible to find that the lengthened RTs occurred for picture naming but not for word naming (reading). Secondly, the lengthened reaction times could have simply been a name agreement type of effect. Previous studies, such as those by Vitkovitch and Tyrrell (1996) found that items with more than one name, such as *sofa* - which may also be called a *settee* or *couch* - took longer to name than items with only one name. Furthermore, items with more than one name because of abbreviations - such as *television* which may also be called a *TV* - did not take longer to name. This suggests that the effect of name agreement occurs when an item has more than one plausible name. This is precisely what the results of Experiments 10 and 11 found. Bilingual participants showed longer reaction times when naming pictures but not when naming the names of the same pictures.

Lengthened reaction times in picture naming but not word naming may be due to the fact that the bilingual participants in these experiments were more likely to speak Italian rather than to read it given that they were in an English environment, which would affect the frequency weightings for time spent functioning in English and time spent functioning in Italian in each modality. Had we performed these experiments on English- Italian bilinguals living in Italy we would expect the opposite results.

Another finding from these naming experiments was that bilinguals were significantly faster at naming the cognate than the non-cognate pictures. A mean advantage of 64 ms for cognate pictures was found. For the monolinguals, on the other hand, there was a difference of only 5 ms between naming the cognate and non-cognate pictures. This cognateness effect was thought to occur because there is a degree of shared overlap between the two lexicons of a bilingual. Non-cognate names are stored separately across the two lexicons. Since ‘true’ (or compound) bilinguals speak each language only half the time as compared to monolinguals, each non-cognate is activated in each language half as many times as it is by a monolingual speaker. This accounts for non-cognates being named slower by bilinguals as compared to monolinguals. Turning to the cognates; as they are, in effect, the same word across the two languages, they are contained within in the overlap of the two languages. As a result, cognates are activated just as frequently as they are for a monolingual.

The work with the English-Italian bilinguals in Chapter 5 also allowed for investigation into the issue of whether bilinguals have one lexicon or two - an age-old debate, but one which the bilingual population at hand gave a chance to investigate. Repetition priming is a well-established experimental technique in cognitive psychology, with repeated presentations of a word or object leading to faster production of the same word or object. This is because the stages required to name a given object or read aloud a given word are accessed on more than one occasion, leading to facilitated access. For this thesis, it was of interest to see if accessing an object's name on one occasion would lead to facilitation in accessing it on a second occasion. Each participant received three sets of objects. One set was seen twice and named in the *same* language on both occasions (either in English on two occasions or in Italian on two occasions), the second was seen twice and named in the *other* language on the second occasion (either in English first and in Italian on the second occasion, or in Italian first and in English on the second occasion) and the last set was only seen once. This was the *unprimed* set and served as a baseline measure. The three sets were counterbalanced, as was the English-then-Italian and Italian-then-English order for the other language set. In addition, each of the three sets comprised half of *cognate* and half of *non-cognate* words. In Experiment 11 naming in phase 2 was carried out in English and in Experiment 12 it was carried out in Italian.

For both experiments, the greatest amounts of priming occurred when participants named the pictures in the same language twice and the least amounts of priming occurred in the condition where participants had not seen the pictures before (the unprimed condition). Some facilitation occurred from having seen the pictures to name once in the other language. That is, previous naming of an item in Italian facilitated its later naming in English (Experiment 11) and previous naming in English facilitated its later naming in Italian on a second occasion. The amount of cross language priming was smaller in Experiment 12, where phase 2 naming occurred in

Italian, which was the less dominant language for the bilinguals. Cross-language priming was due to having accessed links between visual and semantic representations on both occasions, which was why it occurred in both experiments. The fact there was less cross-language priming from English to Italian (Experiment 12) but more cross language priming from Italian to English (Experiment 11) is because of an element of inhibition. For Experiment 12, cross-language priming was less effective than same language priming. The results were thought to provide evidence for suggestions by Kroll and Stewart (1994) that Language 1 to Language 2 translation occurs conceptually but Language 2 to Language 1 translation occurs lexically. These results suggest that access to a cognate in L1 and facilitates its later production in L2, but accessing a cognate in L2 and inhibits its later production in L1. In sum, cognates compete at a lexical level from L1 to L2 production, but with the process occurring vice versa there is no lexical competition since the item will be produced via a conceptual route.

8.5. Grammatical Gender Breakdown in an Italian-English Aphasic

In Chapters 6 and 7, the thesis approached lexical retrieval from yet another direction, that of cognitive neuropsychology. The field has much to contribute to solving problems of lexical retrieval (especially in terms of cognitive neuroscience and with the emerging popularity of techniques such as fMRI), but much of its current problems lies in the fact that reports of case reports still overlook certain clinical implications of bilingualism. These include a lack of detailed descriptions of languages spoken, of history, mode, frequency and patterns of usage.

It is necessary that clinicians, therapists and psychologists pay heed to these issues. Another point for concern is in the nature of stimuli used. There is a distinct shortage of assessment batteries for bilingual patients, the most famous in existence being Paradis' Bilingual Aphasia Test. This absence of published tests with control data has led to assessments having to be carried out with words which are unmatched across languages for factors which affect monolingual naming, and instead direct translations of existing tests for monolingual speakers having to be employed.

This was the case in Chapter 7, which comprised a series of assessments on a bilingual Italian-English aphasic, ED. Although direct translations of English tests were utilised, ED's performance could be compared with the control data from age-matched English monolinguals and also with the performance of five age-matched, language-matched bilinguals. ED had suffered a CVA involving the left hemisphere with a small area of ischaemia in the superior aspect of the left lateral ventricle. Tests of visual processing such as those from the Birmingham Object Recognition Battery (BORB; Riddoch & Humphreys, 1993) confirmed that ED had some visual problems and her performance on naming tasks reflected the presence of some visual agnosia. This was illustrated further by the results of the multiple regression analyses on her correct naming scores in both Italian and English. The only variable which predicted ED's score on picture naming in either language was imageability. No other variable exerted effects in either language, and as imageability is a non-semantic variable its emergence as significant in both languages is not surprising. It was also found that ED's naming performance was better in Italian than it was in English, which is not surprising given that Italian was her only language for the first years of her life, and her more frequently used language.

Several points were noted with regards to grammatical gender. From the evidence on the *explicit* gender tasks, it appeared that ED had an impairment in lemma retrieval in the (main) absence of phonological problems. At times she produced an incorrect gender to a correct name, suggesting that she was performing in accordance with Caramazza's parallel access to lemmas and lexemes arrangement. In the explicit ED gender categorisation, ED sometimes employed incorrect strategies to decide if an object was masculine or feminine, often deciding an item's gender by *association*, even when she was made aware of the noun's article (whether it took *il*, *lo*, *la*, etc.).

ED's bilingualism allowed for the opportunity for *implicit* gender categorisation. It was apparent from the implicit tests that her gender knowledge was actually better preserved than implied by the explicit tasks. The importance of on-line, implicit tasks was emphasised. Off-line data can only highlight the aspect of representations of which the patient is aware and can explicitly reflect on; it manifests little or nothing about the representations of which the patient is *unaware*., which has important implications for the conclusions we would have drawn from ED's performance. If conclusions had been drawn on ED's gender access from her scores on the explicit gender classification tasks *only*, it would have appeared that her gender retrieval was impaired whilst her phonological access remained intact. Instead, she has demonstrated less difficulty in *implicit* gender retrieval.

ED appeared, at first, to show impaired retrieval of grammatical gender in the absence of impaired naming for some object names. Initial testing appeared to show that she was behaving as Caramazza's model predicts, showing parallel access to lemmas and lexemes, and contradicting the cascade model of Levelt et al.'s (1999) framework. However, further testing showed that she was not as impaired on grammatical gender as initially demonstrated. In sum, this chapter emphasised the need for clinicians and therapists to use implicit as well as explicit tests in assessing for naming disorders.

8.6. Future Directions for Research

8.6.1. Studies in Bilingualism - Groups and Stimuli

Clearly, the field of bilingualism requires something of a spring clean. It is important that the area continues to thrive, but it should do so with the employment of homogenous groups and of stringent controls. This includes in experimental methodology as well as in terms of items employed. For example, the two priming experiments in Chapter 5 of this thesis had participants being spoken to in English when performing in English and in Italian when performing in Italian. This resulted in a switch into the other language and back again at least once within the span of each experiment, which may have resulted in slowing down of reactions. Further studies could employ fresh sets of participants per condition - although this would raise issues about controlling for individual variation.

With regards to controlling the stimuli, there are now ratings available for a number of variables in English, and this is extending for other languages such as Spanish and Italian. It is imperative that research in each language should use these measures, in order to provide an opportunity for fair cross-linguistic comparison using the same measures. One important point made in this thesis is that these ratings are usually obtained from monolingual participants. The area of bilingualism would benefit greatly from the availability of such ratings and measures for familiarity, frequency, age of acquisition, etc. from bilingual participants.

8.6.2. Age of Acquisition - An Ageing Debate

The experiments in Chapter 2 confirmed the strong effects of age of acquisition in picture and word naming. It is one thing, however, to document an effect of age of acquisition on picture naming and another to explain how that effect arises. Theoretical explanations of age of acquisition effects in a range of lexical processing tasks focused on the retrieval of phonological representations as a possible locus (e.g., Gilhooly & Watson, 1980; Brown & Watson, 1987). The experiments in Chapter 3 were consistent with this proposal, as AoA effects were found in tasks tapping retrieval of phonological representations but not in tasks tapping retrieval of semantic (syntactic) representations. There are now a number of further issues to address if we are to complete the story.

Firstly, is it *age* of acquisition that is of importance, or *order* of acquisition? This thesis employed the use of compound bilinguals, but employing second language acquirers would have given a chance to explore this further. In some ways, acquisition of second language mimics a name agreement effect - it is the acquisition of a second name to an existing concept. Where the two differ, however, is in order. A second language is usually learned in a similar order to the first, whereas alternative names are not normally learned in a particular order. The modelling studies which are slowly emerging in the literature are providing answers to this. Such studies would also help to clarify whether there exists a threshold age before a word must be learned in order for it to be represented as a whole in the phonological output lexicon.

Secondly, is *age* of acquisition of importance, or *ease* of acquisition? The earlier a word is learned, the more frequently it is generally used in life, and the easier it would therefore be to pronounce. To date, no studies have approached the topic of ease of acquisition. If AoA is a variable arising at a phonological stage of name retrieval, surely with more frequent retrievals there will be less processing required in terms of articulatory programming. Levelt's model includes a self monitoring system whereby speakers monitor internal and overt speech with the result of this being fed back into a monitoring device in the conceptualizer. This allows for speakers to evaluate their messages and avoid or repair speech errors. This could affect the duration of spoken word production as the process of self monitoring could affect duration.

If we take, along with this idea, Brown and Watson's (1987) view that phonological representations of early acquired words are stored in unitary form but that the phonological representations of later acquired words are more fragmentary, it is apparent why the latter take longer to assemble before they can be outputted. It would take longer to monitor a fragmented word than it would to monitor one which had been stored as a whole. Furthermore, in terms of a compound bilingual who speaks both languages with little trace of an accent, there may be less storage in terms of fragmentary word units, but if the bilingual is one who has acquired the second language later in life (or even a second language acquirer still in the process of acquiring it), it is possible that L2 will be stored more or less completely in fragmentary forms. This could also account for the longer reaction times shown by bilinguals in the studies in this thesis, and also the even longer reaction times shown by trilinguals in Mägiste's (1981) studies.

Thus, the general conclusion that this thesis makes, is that there are a number of experimental approaches available to explore both monolingual and bilingual lexical processing. The approaches used in this thesis have included multivariate techniques, task comparisons, acquisition of behavioural data from different populations of participants, and experimental manipulation of item attributes. Future studies in lexical retrieval will benefit from the integration of these approaches.

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APPENDIX 1

Core Items in Experiments 1 and 3 (English Picture and Word Naming)

VComp = Visual Complexity
Fam = Familiarity
R Freq = Rated Frequency
CCom Celex Combined Frequency
CWr = Celex Written Frequency
CSp = Celex Spoken Frequency
O AoA = Objective Age of Acquisition
R AoA = Rated Age of Acquisition
PhN Phonological Neighbours
OrthN = Orthographic Neighbours
NAgree = Name Agreement
Phons = Phoneme Length
Sylls = Syllable Length
Letts = Letter Length
RT Pic = Picture Naming Reaction Time (ms)
RT Wd = Word Naming Reaction Time (ms)

Item	VComp	Fam	R Freq	CCom	CWr	CSp	O AoA	R AoA	PhN	OrthN	NAgree	Phons	Sylls	Letts	E RT Pic	E RT Wd
accordion	4.68	1.62	1.30	1	1	2	140.00	4.65	0	0	0.68	8	4	9	1391	666
anchor	2.30	1.73	1.75	5	5	0	102.50	3.35	1	0	1.00	4	2	6	1007	516
ant	3.70	2.75	2.50	4	4	2	62.50	2.30	5	5	0.86	3	1	3	1085	481
apple	1.75	4.48	3.90	18	19	4	20.50	1.70	2	1	1.00	3	2	5	847	466
arm	1.80	4.73	4.15	104	110	22	38.50	1.55	11	5	1.00	2	1	3	927	468
asparagus	3.32	2.14	2.30	1	1	0	140.00	5.90	0	0	0.60	9	4	9	1389	669
axe	1.85	2.14	1.85	0	0	0	62.50	2.95	9	8	1.00	3	1	3	1016	490
ball	2.25	3.36	3.45	93	97	37	26.50	1.35	24	15	0.91	3	1	4	1012	495
balloon	1.25	2.86	2.90	3	3	2	20.50	1.85	4	0	1.00	5	2	7	840	496
banana	1.25	3.71	3.70	4	4	2	26.50	1.80	0	0	0.91	6	3	6	682	486
bear	3.40	1.73	2.60	6	6	3	50.50	1.95	19	19	0.60	2	1	4	898	554
bed	2.45	4.86	4.70	244	257	78	20.50	1.45	31	14	1.00	3	1	3	764	474
bell	2.55	2.50	2.50	27	27	37	44.50	2.40	23	15	1.00	3	1	4	765	492
belt	1.70	3.81	3.20	20	21	9	50.50	3.00	14	13	0.90	4	1	4	909	486
bicycle	3.85	4.09	3.65	8	8	11	26.50	2.40	0	0	0.64	3	1	7	777	496
blackboard	2.85	3.45	2.30	5	5	13	92.50	2.70	2	0	0.65	7	2	10	936	540
book	2.45	4.68	4.70	269	250	524	20.50	1.80	20	18	1.00	3	1	4	746	505
boot	2.05	4.23	4.15	8	9	2	26.50	2.55	27	17	0.96	3	1	4	928	506
bottle	1.40	4.41	4.25	82	88	10	38.50	2.10	6	0	0.96	4	2	6	843	476

bread	1.50	4.68	4.40	74	78	26	38.50	1.70	13	5	0.96	4	1	5	942	506
broom	2.45	2.73	2.15	6	7	0	86.50	2.90	7	3	0.68	4	1	5	1092	515
brush	2.60	3.68	3.45	12	13	4	26.50	2.30	4	2	0.82	4	1	5	922	512
bullet	2.70	2.55	1.85	13	14	3	86.50	3.20	5	1	1.00	5	2	6	1216	502
bus	4.15	3.95	3.85	64	66	47	26.50	2.20	20	10	0.82	3	1	3	838	494
butterfly	4.05	2.73	2.55	5	5	0	26.50	2.20	0	0	1.00	7	3	9	758	532
button	2.02	4.09	3.05	15	16	8	38.50	2.05	5	2	1.00	4	2	6	868	504
cactus	2.15	2.70	1.80	2	2	0	114.50	3.75	0	0	1.00	6	2	6	891	598
cake	2.80	3.32	3.40	21	22	5	26.50	1.90	25	18	1.00	3	1	4	835	508
candle	2.25	3.32	3.05	8	8	4	38.50	2.80	7	2	1.00	5	2	6	835	520
cannon	3.70	1.64	1.50	3	3	1	114.50	3.85	2	1	1.00	5	2	6	979	556
cap	2.18	2.91	2.05	27	29	7	68.50	2.90	29	21	0.91	3	1	3	1081	530
caravan	3.20	2.85	2.30	7	6	19	56.50	3.85	0	0	1.00	7	3	7	905	597
carrot	2.65	4.23	3.40	3	3	1	32.50	2.05	4	1	1.00	5	2	6	775	535
cat	2.60	4.00	3.40	41	44	9	26.50	1.50	33	19	1.00	3	1	3	768	525
chain	2.50	2.57	2.60	33	34	15	56.50	3.25	19	1	0.96	3	1	5	924	514
chair	2.10	4.77	4.00	103	110	12	20.50	1.85	17	1	1.00	2	1	5	747	515
cheese	2.00	4.60	3.95	28	29	5	44.50	2.30	27	0	1.00	3	1	6	852	538
cherry	1.60	2.43	2.75	5	5	2	74.50	2.80	11	2	0.95	4	2	6	1215	565
church	3.75	3.09	3.20	0	163	103	44.50	2.70	7	0	0.96	3	1	6	921	574
cigarette	2.10	3.86	3.30	49	52	19	86.50	3.35	0	0	1.00	7	3	9	990	554
cloud	1.15	4.05	3.35	30	31	10	56.50	2.30	10	1	1.00	4	1	5	766	544
clown	3.90	2.09	2.00	3	3	0	38.50	2.35	7	5	1.00	4	1	5	843	523
comb	2.00	3.68	3.05	4	4	3	38.50	2.10	21	4	1.00	3	1	4	750	555
cow	3.85	3.18	2.90	22	23	9	26.50	1.95	19	19	1.00	2	1	3	954	529
crab	3.75	2.55	1.95	4	5	0	50.50	2.70	9	8	1.00	4	1	4	980	498
crown	3.75	1.68	1.80	23	23	17	56.50	2.60	9	5	1.00	4	1	5	840	530
cymbals	4.25	2.40	1.40	1	1	0	140.00	3.70	2	0	1.00	6	2	7	1103	639
dentist	4.05	2.95	2.60	6	7	2	86.50	2.90	2	0	1.00	7	2	7	1367	506
desk	3.30	4.60	3.60	82	87	15	86.50	2.80	2	3	0.91	4	1	4	1058	478

diamond	3.10	1.65	1.95	8	8	2	86.50	3.80	0	0	0.65	6	2	7	1011	517
doctor	4.35	3.65	3.15	132	136	83	44.50	2.75	0	0	0.95	5	2	6	1049	478
dog	2.70	4.05	3.50	69	71	39	20.50	1.50	17	20	1.00	3	1	3	767	480
donkey	3.10	1.95	2.10	9	10	1	50.50	2.25	3	1	0.91	5	2	6	1037	499
door	2.65	4.73	4.50	328	347	86	20.50	1.90	19	4	1.00	2	1	4	755	558
dragon	4.40	2.35	1.75	8	8	3	44.50	2.25	2	0	1.00	5	2	6	985	509
dress	3.45	3.14	3.20	74	78	20	38.50	2.05	6	4	1.00	4	1	5	972	539
drum	2.65	2.41	2.35	7	8	5	50.50	2.00	7	1	1.00	4	1	4	840	510
eagle	4.18	2.05	1.95	7	8	2	86.50	3.20	3	1	0.64	4	2	5	1149	488
ear	2.85	4.59	3.20	42	43	21	44.50	1.55	5	10	1.00	1	1	3	706	489
elephant	4.12	2.18	2.10	6	6	4	26.50	2.05	2	0	1.00	7	3	8	735	524
envelope	1.40	4.30	3.15	19	20	7	68.50	3.45	0	0	0.96	7	3	8	857	534
eye	3.48	4.50	3.25	127	131	78	44.50	1.70	12	6	1.00	1	1	3	723	497
finger	2.35	4.68	3.35	48	51	9	26.50	1.65	1	4	1.00	5	2	6	820	523
fish	2.95	3.09	3.05		85	24	20.50	2.05	9	7	1.00	3	1	4	749	498
flag	2.00	2.22	2.15	9	10	6	38.50	3.20	7	3	1.00	4	1	4	793	501
flask	2.55	3.05	1.90	4	4	2	102.50	3.75	0	0	0.75	5	1	5	1136	522
flower	2.80	3.27	3.00	27	27	20	20.50	1.70	2	2	1.00	4	2	6	885	500
fly	3.55	3.23	3.10	17	18	6	56.50	2.15	8	4	0.96	3	1	3	1183	520
foot	1.85	4.59	3.50	98	100	72	38.50	1.50	11	13	0.96	3	1	4	800	511
fork	2.20	4.55	4.00	12	12	5	26.50	1.75	21	7	1.00	3	1	4	883	513
fridge	2.40	4.48	4.25	4	4	3	56.50	2.40	3	1	0.70	4	1	6	993	544
frog	3.60	2.38	2.25	4	4	12	26.50	2.10	5	4	0.91	4	1	4	801	527
giraffe	4.35	1.55	1.85	1	1	0	38.50	2.30	0	0	0.96	5	2	7	816	634
glass	1.95	4.45	4.10	125	132	42	44.50	2.35	3	1	0.96	4	1	5	822	537
glasses	2.60	3.82	3.85	32	34	7	26.50	2.80	4	1	0.86	6	2	7	824	526
gorilla	3.20	1.64	1.85	2	2	0	62.50	2.85	0	0	0.86	6	3	7	1010	537
grapes	3.35	3.00	3.05	8	8	1	56.50	2.65	8	9	1.00	5	1	6	853	514
guitar	3.10	3.00	2.65	6	6	7	62.50	3.35	1	0	1.00	4	2	6	772	535
gun	2.75	2.00	2.35	63	67	20	44.50	2.75	21	13	0.85	3	1	3	789	508

hair	2.88	4.45	4.25	191	201	54	56.50	1.60	18	4	0.95	2	1	4	1085	494
hammer	2.55	2.82	2.25	9	9	8	32.50	2.45	4	3	1.00	4	2	6	804	521
hand	2.80	4.59	3.95	440	456	235	26.50	1.50	14	7	1.00	4	1	4	824	493
harp	3.70	1.68	1.45	2	3	1	126.50	4.00	17	8	1.00	3	1	4	1001	495
hat	2.15	2.59	2.90	53	55	26	26.50	2.10	34	24	0.96	3	1	3	751	484
heart	1.05	3.09	3.00	145	151	59	50.50	2.45	26	0	0.91	3	1	5	809	512
helicopter	4.20	2.00	2.00	11	11	5	26.50	3.00	0	0	0.82	9	4	10	837	516
horse	3.45	2.82	2.75	6	89	32	26.50	1.85	15	3	1.00	3	1	5	761	512
judge	4.15	2.05	2.20	4	4	2	102.50	4.25	5	2	1.00	3	1	5	1106	564
jug	1.85	3.23	2.40	8	9	2	56.50	2.75	15	14	1.00	3	1	3	816	512
kangaroo	3.70	1.41	1.60	1	1	1	44.50	3.05	0	0	0.96	7	3	8	891	521
key	2.05	4.68	4.70	70	73	29	26.50	2.35	26	8	0.96	2	1	3	869	537
king	3.70	3.00	2.05	89	93	43	56.50	2.10	16	6	1.00	3	1	4	937	532
knife	1.95	4.82	4.30	35	38	8	26.50	2.10	9	0	0.96	3	1	5	873	479
ladder	2.55	2.64	2.40	13	14	9	32.50	2.55	7	5	0.96	4	2	6	877	491
ladybird	2.35	3.00	1.90	0	0	0	38.50	2.30	0	0	1.00	7	3	8	1129	499
leaf	2.75	3.41	3.05	15	16	6	32.50	2.05	23	5	1.00	3	1	4	959	492
leg	2.15	4.73	3.70	63	67	12	38.50	1.50	14	8	0.96	3	1	3	917	456
lemon	1.30	2.95	2.60	13	14	0	44.50	2.40	2	1	1.00	5	2	5	937	480
lightbulb	3.25	4.30	2.45	0	0	0	74.50	3.10	0	0	0.65	7	2	9	825	539
lion	3.25	1.91	2.00	8	9	6	26.50	1.75	5	1	1.00	4	2	4	853	505
lips	1.55	4.67	2.85	61	66	5	50.50	1.75	19	12	0.68	4	1	4	823	491
lobster	4.25	1.77	1.70	2	2	0	86.50	4.20	1	0	0.91	6	2	7	1235	505
lorry	2.25	3.41	2.80	8	8	12	44.50	2.10	5	2	0.75	4	2	5	994	466
monkey	3.20	2.09	2.10	9	9	5	32.50	2.40	4	1	0.86	5	2	6	965	515
moon	1.05	3.32	3.00	53	55	23	32.50	2.10	21	11	0.91	3	1	4	930	463
motorbike	4.15	3.32	2.80	0	0	0	38.50	3.00	0	0	0.85	7	3	9	839	523
mountain	2.30	2.41	2.30	46	49	7	62.50	2.95	5	1	0.90	6	2	8	867	477
mouse	3.00	2.59	2.30	8	9	3	26.50	2.05	17	6	0.82	3	1	5	815	475
mushroom	3.12	3.18	3.30	5	5	3	62.50	2.75	0	0	0.82	6	2	8	846	501

necklace	1.78	2.86	2.60	2	2	0	50.50	2.60	3	0	0.68	6	2	6	928	532
needle	1.55	2.77	2.60	9	10	3	86.50	2.70	7	0	0.86	4	2	4	1135	465
nose	1.35	4.63	3.60	73	76	32	56.50	1.50	27	8	1.00	3	1	5	883	534
nurse	4.30	3.70	2.95	31	32	14	50.50	2.45	13	5	1.00	3	1	5	862	550
onion	2.85	3.95	3.45	9	10	1	68.50	2.55	0	0	1.00	5	2	6	1057	508
orange	2.12	3.73	3.45	14	15	3	38.50	1.85	0	0	1.00	5	2	7	1010	487
ostrich	3.15	1.41	1.65	2	2	0	102.50	3.80	0	0	0.73	6	2	7	1153	513
parachute	2.40	2.15	2.05	3	3	1	86.50	3.95	0	0	1.00	7	3	9	1112	554
peacock	4.25	1.91	2.05	3	3	2	92.50	3.60	1	0	0.96	5	2	7	1156	506
pear	1.20	3.23	2.95	2	3	1	44.50	2.35	18	16	1.00	2	1	4	927	562
pencil	2.05	4.00	4.05	15	16	3	38.50	2.25	0	0	1.00	6	2	6	737	473
penguin	2.60	1.86	2.00	4	4	7	38.50	3.05	0	0	0.91	7	2	7	883	509
pepper	2.48	3.59	3.60	7	7	2	114.50	2.80	7	3	0.95	4	2	6	1295	507
pig	2.70	2.36	2.50	18	19	4	26.50	1.80	20	15	0.96	3	1	3	825	458
pineapple	3.60	2.36	2.65	2	2	4	74.50	3.05	0	0	0.86	6	3	9	843	517
pipe	1.95	2.18	2.05	22	22	21	74.50	2.70	16	6	1.00	3	1	4	810	480
potato	2.20	3.91	3.90	11	12	2	74.50	2.10	0	0	0.82	6	3	6	1173	541
pram	3.55	2.40	2.10	5	6	1	38.50	1.75	8	8	1.00	4	1	4	849	490
pumpkin	2.60	1.77	1.75	1	1	0	74.50	3.80	1	1	1.00	7	2	7	1025	495
queen	3.90	3.05	2.35	50	50	43	44.50	2.45	4	1	1.00	4	1	5	959	502
rabbit	2.65	2.81	2.80	11	11	3	20.50	1.85	5	0	0.95	5	2	6	836	477
rhinoceros	4.15	1.64	1.60	1	1	0	86.50	3.30	0	0	0.67	9	4	10	959	628
ring	2.55	3.82	3.45	35	35	32	50.50	2.40	21	10	0.95	3	1	4	1015	496
saw	2.25	2.41	2.05	0	0	0	68.50	2.55	21	10	1.00	2	1	3	925	551
scales	3.10	3.20	2.60	9	10	2	86.50	3.55	8	1	0.87	5	1	6	1129	601
scarecrow	4.30	2.15	1.85	1	1	0	44.50	3.20	0	0	1.00	6	2	9	960	658
scissors	2.20	3.91	3.45	4	5	2	26.50	2.65	7	0	1.00	5	2	8	728	554
screw	2.90	2.77	2.65	7	7	2	80.50	3.42	3	1	0.96	4	1	5	1190	616
screwdriver	1.90	2.73	2.50	0	0	0	68.50	3.45	0	0	1.00	9	3	11	1094	609
seal	2.90	1.64	2.15	1	1	0	68.50	3.25	30	12	0.65	3	1	4	1115	547

shawl	3.70	2.30	1.55	5	5	0	140.00	4.30	19	1	0.90	3	1	5	1099	583
sheep	3.30	2.86	2.80	20	21	7	44.50	1.90	25	3	0.96	3	1	5	1140	560
shell	3.90	2.75	2.15	28	29	14	56.50	2.30	17	4	1.00	3	1	5	1133	529
shoe	3.20	4.68	4.25	14	15	5	20.50	1.50	22	5	1.00	2	1	4	813	550
ski	3.05	2.05	2.25	3	4	17	102.50	3.50	3	2	1.00	3	1	3	1254	626
skirt	3.15	3.55	3.30	20	21	7	56.50	2.55	12	2	0.90	4	1	5	981	561
slide	3.95	2.90	2.45	9	8	21	20.50	2.30	14	3	1.00	4	1	5	995	553
snail	2.70	2.45	2.10	3	3	0	44.50	2.20	4	0	1.00	4	1	5	935	571
snake	3.55	2.05	2.30	14	14	8	32.50	2.50	8	4	1.00	4	1	5	836	579
sofa	2.28	4.14	3.60	0	0	0	92.50	2.85	1	1	0.65	4	2	4	749	544
spider	3.15	3.09	3.05	4	4	2	32.50	2.26	0	0	0.95	5	2	6	1126	585
spoon	1.90	4.64	4.05	11	12	1	20.50	1.60	11	6	0.91	4	1	5	862	576
star	1.00	3.09	3.05	53	55	26	38.50	2.10	6	7	0.96	3	1	4	745	579
stool	2.35	3.50	2.60	9	9	2	50.50	2.35	10	3	1.00	4	1	5	1046	616
strawberry	2.55	2.77	2.75	3	3	0	44.50	2.45	0	0	1.00	8	3	10	995	576
submarine	2.95	1.40	1.85	1	1	1	102.50	3.65	23	0	0.95	8	3	9	1176	585
swan	2.65	2.23	2.45	5	5	4	62.50	2.50	10	8	1.00	4	1	4	847	539
syringe	3.00	2.50	2.05	0	0	0	140.00	4.80	0	0	0.80	6	2	7	1113	609
table	2.05	4.50	4.20	203	214	64	20.50	1.85	6	2	1.00	4	2	5	844	503
telephone	3.52	4.36	4.35	97	100	59	26.50	2.20	0	0	0.64	7	3	9	774	508
thimble	3.35	1.73	1.70	0	0	0	140.00	3.35	2	0	0.95	5	2	7	1082	593
tie	2.65	2.91	2.90	19	20	9	56.50	3.35	23	13	1.00	2	1	3	831	502
tiger	4.35	1.77	2.20	4	5	2	44.50	2.10	4	1	0.80	4	2	5	950	523
toast	4.00	3.70	3.95	14	15	2	50.50	1.75	12	3	0.95	4	1	5	896	514
toaster	3.50	3.86	3.35	1	1	0	50.50	3.45	6	3	1.00	5	2	7	868	522
tortoise	3.10	2.10	1.95	4	4	0	38.50	3.00	1	0	1.00	5	2	8	912	525
towel	3.50	4.70	3.95	15	17	1	38.50	2.30	6	3	0.95	3	1	5	1018	523
train	3.45	3.64	3.05	68	65	109	32.50	2.40	9	6	0.95	4	1	5	894	527
tree	3.45	4.50	3.55	72	77	9	20.50	1.70	9	5	1.00	3	1	4	840	536
trousers	2.30	4.90	3.90	28	29	21	32.50	1.70	0	0	1.00	6	2	8	828	540

trumpet	3.15	2.05	1.90	5	5	2	56.50	3.10	2	2	0.96	7	2	7	978	543
umbrella	2.95	3.41	2.50	11	12	9	26.50	2.65	0	0	0.96	7	3	8	783	512
vase	3.40	2.50	2.50	4	4	0	62.50	3.25	14	6	1.00	3	1	4	875	551
waistcoat	2.80	3.23	2.60	3	3	1	86.50	4.60	0	0	1.00	6	2	9	1025	510
well	3.82	3.82	2.20	0	0	0	86.50	2.70	23	14	0.91	3	1	4	820	500
wheel	3.35	2.68	2.95	28	28	22	32.50	2.16	29	1	0.86	3	1	5	777	496
wheelbarrow	2.40	2.80	2.00	1	1	0	44.50	3.00	0	0	0.95	7	3	8	882	536
zebra	4.30	1.41	1.75	1	1	1	44.50	2.50	0	0	1.00	5	2	5	1024	532

APPENDIX 2

Core Items in Experiments 2 and 4 (Italian Picture and Word Naming)

VComp = Visual Complexity
R Freq = Rated Frequency
PhN = Phonological Neighbours
Phons = Phoneme Length
RT Wd = Word Naming Reaction Time (ms)
Fam = Familiarity
R AoA = Rated Age of Acquisition
OrthN = Orthographic Neighbours
Letts = Letter Length
WFreq = Written Frequency
NAgree = Name Agreement
Sylls = Syllable Length
RT Pic = Picture Naming Reaction Time (ms)

English Translation	It Item	VComp	Fam	WFreq	R Freq	R AoA	NAgree	PhN	OrthN	Sylls	Phons	Letts	RT Pic	RT Wd
accordion	fisarmonica	4.68	1.77	0	2.24	3.19	1.00	1	0	5	11	11	1103	674
anchor	ancora	2.30	1.68	0	2.62	2.81	1.00	2	1	3	6	6	963	594
ant	formica	3.70	3.64	1	3.48	2.05	0.85	1	0	3	7	7	1263	579
apple	mela	1.75	4.64	10	4.29	1.67	1.00	10	6	2	4	4	994	553
arm	braccio	1.80	4.50	28	4.62	1.67	0.90	2	1	2	6	7	1029	551
asparagus	asparago	3.32	2.91	0	2.90	4.14	0.85	0	1	4	8	8	1433	613
axe	ascia	1.85	1.77	0	2.19	3.21	0.75	2	1	2	3	5	1046	571
ball	palla	2.25	3.41	9	4.24	1.74	0.80	12	4	2	4	5	964	551
balloon	pallone	1.25	2.50	4	3.29	1.83	0.85	4	1	3	6	7	1113	546
banana	banana	1.25	4.23	0	4.05	2.00	1.00	1	1	3	6	6	807	540
bear	orso	3.40	1.23	8	2.71	2.26	0.95	6	2	2	4	4	1029	524
bed	letto	2.45	5.00	83	4.86	1.50	1.00	13	8	2	4	5	851	519
bell	campana	2.55	2.86	1	3.69	2.81	0.90	1	2	3	7	7	928	585
belt	cintura	1.70	4.64	2	3.76	2.22	0.75	2	1	3	7	7	1026	623
bicycle	bicicletta	3.85	4.73	9	4.04	1.95	1.00	1	1	4	9	10	787	594
blackboard	lavagna	2.85	5.00	2	3.01	2.25	0.95	1	1	3	7	7	1052	535
book	libro	2.45	5.00	23	4.86	2.25	1.00	1	1	2	5	5	876	544
boot	stivale	2.05	4.32	1	3.19	2.63	0.75	1	1	3	7	7	1117	617
bottle	bottiglia	1.40	4.95	8	4.81	1.71	1.00	1	1	3	7	9	940	536

bread	pane	1.50	4.95	35	4.95	1.62	0.90	9	5	2	4	4	1116	530
broom	scopa	2.45	4.59	0	3.08	2.05	0.95	2	3	2	5	5	973	634
brush	spazzola	2.60	3.91	0	4.38	2.95	1.00	1	1	3	7	8	1079	639
bullet	proiettile	2.70	1.36	0	2.76	3.19	0.95	1	1	4	8	10	1338	630
bus	autobus	4.15	4.77	0	4.33	2.71	0.70	0	0	3	6	7	1169	581
butterfly	farfalla	4.05	3.14	2	3.43	2.29	1.00	1	1	3	7	8	856	564
button	bottone	2.02	4.82	3	3.16	2.19	0.95	2	2	3	6	7	927	561
cactus	cactus	2.15	2.50	0	1.86	3.67	1.00	0	0	2	6	6	1062	601
cake	torta	2.80	3.82	3	3.71	1.67	1.00	7	5	2	5	5	999	558
candle	candela	2.25	3.55	1	3.19	2.25	1.00	1	1	3	7	7	926	578
cannon	cannone	3.70	1.50	1	2.33	2.71	0.95	1	1	3	6	7	1001	577
cap	berretto	2.18	3.55	0	2.81	2.95	0.75	1	1	3	6	8	1171	613
caravan	roulotte	3.20	2.50	0	2.76	3.67	0.80	0	0	2	5	8	1162	612
carrot	carota	2.65	4.14	1	3.95	2.71	1.00	1	1	3	6	6	868	562
cat	gatto	2.60	4.18	32	4.19	1.43	1.00	8	5	2	4	5	884	555
chain	catena	2.50	3.73	19	2.90	3.00	0.95	1	1	3	6	6	991	540
chair	sedia	2.10	4.95	9	4.86	1.86	1.00	2	2	3	5	5	830	597
cheese	formaggio	2.00	4.45	4	4.57	2.10	0.70	0	0	3	8	9	884	576
cherry	ciliegia	1.60	2.50	1	3.00	2.57	0.85	1	1	4	7	8	1140	625
church	chiesa	3.75	4.00	61	3.86	2.71	0.90	2	1	2	5	6	1092	590
cigarette	sigaretta	2.10	4.82	15	4.52	2.72	0.90	1	1	4	8	9	949	620
cloud	nuvola	1.15	4.82	5	3.57	2.10	1.00	1	1	3	6	6	941	564
clown	clown	3.90	1.64	0	2.33	3.10	0.75	0	0	1	5	5	1141	604
comb	pettine	2.00	4.73	0	4.33	2.22	1.00	1	1	3	6	7	907	571
cow	mucca	3.85	3.09	0	3.14	2.32	1.00	1	0	2	4	5	1085	531
crab	granchio	3.75	1.86	0	3.00	3.00	1.00	0	0	2	7	8	1149	617
crown	corona	3.75	1.36	10	2.33	2.24	1.00	1	1	3	6	6	1074	574
cymbals	piattini	4.25	1.64	0	3.90	3.37	0.80	2	2	3	7	8	1262	641
dentist	dentista	4.05	2.09	2	2.95	2.94	0.95	2	2	3	8	8	1384	557
desk	scrivania	3.30	4.91	3	3.29	2.78	0.75	1	1	4	9	9	1096	677

diamond	diamante	3.10	1.64	0	2.19	3.05	0.90	1	1	4	8	8	1099	607
doctor	dottore	4.35	2.55	44	3.62	1.95	0.80	1	1	3	5	7	1105	571
dog	cane	2.70	4.27	47	4.14	1.81	1.00	6	4	2	4	4	938	543
donkey	asino	3.10	1.91	0	2.81	2.10	0.95	1	1	3	5	5	1132	549
door	porta	2.65	5.00	21	4.71	2.21	1.00	7	5	2	5	5	816	532
dragon	drago	4.40	1.45	0	1.90	2.29	0.95	3	1	2	5	5	1048	560
dress	vestito	3.45	3.68	8	4.62	2.86	0.85	1	1	3	7	7	1091	534
drum	tamburo	2.65	2.27	0	2.29	3.05	0.85	1	1	4	7	7	1101	550
eagle	aquila	4.18	1.64	4	2.33	2.90	0.80	1	1	3	6	6	1247	550
ear	orecchio	2.85	4.50	9	4.19	1.71	0.95	0	0	3	6	8	875	536
elephant	elefante	4.12	1.41	3	2.52	2.48	1.00	1	1	4	8	8	847	533
envelope	busta	1.40	4.64	4	4.14	2.86	0.70	4	1	2	5	5	1060	540
eye	occhio	3.48	5.00	28	4.38	1.67	0.95	1	0	2	4	6	845	546
finger	dito	2.35	5.00	10	4.38	1.80	0.75	5	1	2	4	4	1053	602
fish	pesce	2.95	3.73	12	3.86	2.14	1.00	4	2	2	4	5	873	542
flag	bandiera	2.00	3.27	8	3.10	3.06	1.00	1	1	3	8	8	926	558
flask	thermos	2.55	3.27	0	2.62	2.95	0.85	0	0	2	6	7	1413	671
flower	fiore	2.80	4.50	12	3.76	2.19	0.95	1	1	2	5	5	973	581
fly	mosca	3.55	4.41	3	3.71	2.06	0.90	2	0	2	5	5	1251	529
foot	piede	1.85	5.00	0	4.43	1.71	1.00	1	1	3	5	5	808	581
fork	forchetta	2.20	1.41	3	4.81	2.00	1.00	2	2	2	7	9	857	585
fridge	frigorifero	2.40	5.00	0	4.67	2.37	0.95	1	0	5	11	11	917	606
frog	rana	3.60	2.18	0	2.08	2.35	0.95	7	5	2	4	4	908	544
giraffe	giraffa	4.35	1.32	0	2.08	2.43	1.00	1	1	3	6	7	898	543
glass	bicchiere	1.95	4.86	10	4.90	1.86	1.00	1	1	3	7	9	850	576
glasses	occhiali	2.60	4.95	8	4.57	2.57	1.00	0	0	3	6	8	829	530
gorilla	gorilla	3.20	1.41	0	2.00	2.57	0.80	0	0	3	6	7	1231	540
grapes	uva	3.35	3.45	15	3.38	2.19	0.95	0	0	2	3	3	991	527
guitar	chitarra	3.10	3.55	0	3.19	2.28	1.00	1	1	3	6	8	863	581
gun	pistola	2.75	1.55	5	2.81	2.71	0.90	1	1	3	7	7	835	567

hair	capelli	2.88	5.00	38	4.62	1.90	0.95	1	1	3	6	7	1156	578
hammer	martello	2.55	3.14	4	3.00	2.44	1.00	1	1	3	7	8	924	530
hand	mano	2.80	4.50	98	4.67	1.67	1.00	3	3	2	4	4	924	542
harp	arpa	3.70	1.73	0	2.00	3.19	1.00	4	1	2	4	4	997	547
hat	cappello	2.15	3.68	8	3.38	2.44	1.00	1	1	3	6	8	837	572
heart	cuore	1.05	3.50	61	4.00	2.19	1.00	1	1	2	5	5	787	579
helicopter	elicottero	4.20	2.27	0	2.48	2.63	0.95	1	1	5	9	10	860	583
horse	cavallo	3.45	3.23	31	2.86	1.80	1.00	1	1	3	6	7	889	550
judge	giudice	4.15	1.50	3	3.05	3.71	0.95	1	1	3	6	7	1234	626
jug	brocca	1.85	4.36	1	3.10	3.00	0.75	1	0	2	5	6	1087	558
kangaroo	canguro	3.70	1.23	0	2.14	3.81	1.00	1	1	3	7	7	974	558
key	chiave	2.05	5.00	15	4.52	2.29	1.00	1	1	2	5	6	922	587
king	re	3.70	1.32	76	2.48	2.38	1.00	6	7	1	2	2	934	524
knife	coltello	1.95	5.00	6	4.76	2.00	1.00	1	1	3	7	8	914	534
ladder	scala	2.55	3.91	13	4.14	2.10	0.85	3	1	2	5	5	1096	650
ladybird	coccinella	2.35	2.55	0	2.38	2.89	0.95	1	1	4	8	10	1207	622
leaf	foglia	2.75	4.27	8	3.24	2.06	0.90	3	3	2	6	6	993	581
leg	gamba	2.15	4.50	16	4.24	1.62	0.80	1	1	2	5	5	1094	544
lemon	limone	1.30	4.50	7	3.90	2.60	1.00	2	1	3	6	6	884	521
lightbulb	lampadina	3.25	4.95	2	3.71	2.16	1.00	1	1	4	9	9	888	561
lion	leone	3.25	1.59	4	2.62	3.10	1.00	1	1	3	5	5	948	523
lips	labbra	1.55	5.00	15	4.00	2.06	0.60	1	1	2	5	5	1136	538
lobster	aragosta	4.25	1.95	0	2.33	3.33	0.65	1	1	4	8	8	1143	573
lorry	camion	2.25	4.41	6	3.62	2.79	0.95	0	0	3	6	6	1336	595
monkey	scimmia	3.20	1.36	0	2.02	2.22	0.85	1	0	3	5	7	1121	600
moon	luna	1.05	4.41	17	3.76	2.00	1.00	5	4	2	4	4	912	513
motorbike	motocicletta	4.15	4.36	8	3.67	2.57	0.85	1	1	5	11	12	994	615
mountain	montagna	2.30	2.59	22	3.71	2.14	0.80	1	1	3	8	8	1112	587
mouse	topo	3.00	1.91	3	2.95	2.48	0.90	4	3	2	4	4	935	564
mushroom	fungo	3.12	3.68	1	3.14	3.05	1.00	7	3	2	5	5	912	597

necklace	collana	1.78	4.09	2	3.68	2.45	0.95	1	1	3	6	6	943	570
needle	ago	1.55	3.18	0	3.43	2.21	0.90	1	4	2	3	3	1168	550
nose	naso	1.35	5.00	20	4.38	1.86	0.95	6	4	2	4	4	995	538
nurse	infermiera	4.30	2.05	4	3.24	3.29	0.90	2	2	4	10	10	1038	578
onion	cipolla	2.85	4.36	0	4.19	2.30	0.95	1	0	3	6	7	1186	575
orange	arancia	2.12	4.18	6	4.05	2.48	0.75	3	1	3	7	7	1304	540
ostrich	struzzo	3.15	1.50	0	1.95	3.00	0.90	2	1	2	6	7	1377	649
parachute	paracadute	2.40	1.64	0	2.29	3.33	0.95	1	1	5	10	10	1258	646
peacock	pavone	4.25	1.91	0	2.38	2.71	1.00	3	7	3	6	6	1074	555
pear	pera	1.20	3.82	0	3.86	2.19	1.00	9	10	2	4	4	853	537
pencil	matita	2.05	4.45	0	4.38	2.29	0.95	1	1	3	6	6	1042	533
penguin	pinguino	2.60	1.27	0	2.14	2.62	0.95	1	1	3	8	8	968	599
pepper	peperone	2.48	3.91	0	3.52	2.95	0.95	1	1	4	8	8	1204	574
pig	maiale	2.70	2.14	2	3.03	2.35	0.90	1	0	3	6	6	1173	518
pineapple	ananas	3.60	2.68	0	2.86	2.90	1.00	0	5	3	6	6	963	593
pipe	pipa	1.95	2.59	4	2.43	3.11	1.00	2	1	2	4	4	825	558
potato	patata	2.20	4.32	1	3.95	2.42	0.85	1	1	3	6	6	1163	547
pram	carrozzina	3.55	3.23	0	2.76	2.44	0.75	1	1	4	8	10	1045	643
pumpkin	zucca	2.60	2.41	1	2.76	2.63	0.95	5	1	2	4	5	1357	596
queen	regina	3.90	1.41	20	2.29	2.21	1.00	1	0	3	6	6	1018	534
rabbit	coniglio	2.65	3.18	0	2.95	3.00	1.00	1	0	3	8	8	940	580
rhinoceros	rinoceronte	4.15	1.27	0	2.19	2.71	0.95	1	1	5	11	11	994	665
ring	anello	2.55	4.23	6	3.71	2.62	1.00	1	1	3	5	6	1113	532
saw	sega	2.25	2.27	0	2.48	3.10	0.85	5	0	2	4	4	1200	605
scales	bilancia	3.10	4.00	5	4.28	2.86	1.00	1	0	3	8	8	1034	544
scarecrow	spaventapasseri	4.30	1.86	0	1.81	3.10	0.75	0	0	6	14	15	1263	779
scissors	forbici	2.20	4.14	0	3.81	2.62	0.95	1	7	3	7	7	863	606
screw	vite	2.90	3.73	0	3.14	2.94	0.70	8	0	2	4	4	1181	565
screwdriver	cacciavite	1.90	3.32	0	2.71	3.67	0.70	1	4	4	9	10	1249	644
seal	foca	2.90	1.45	0	2.19	2.95	0.85	3	1	2	4	4	1082	568

shawl	scialle	3.70	2.59	1	2.57	3.86	0.80	7	1	2	4	7	1192	639
sheep	pecora	3.30	2.82	1	2.95	2.20	0.90	1	1	3	6	6	1210	573
shell	conchiglia	3.90	2.14	1	3.52	2.76	0.95	1	1	3	9	10	1114	582
shoe	scarpa	3.20	5.00	16	4.52	1.62	1.00	1	1	3	6	6	980	685
ski	sci	3.05	1.50	4	2.86	3.38	0.95	9	0	2	2	3	1139	630
skirt	gonna	3.15	4.59	3	3.90	2.38	1.00	3	4	1	4	5	892	577
slide	scivolo	3.95	2.50	0	2.19	2.33	0.95	1	1	3	6	7	1164	646
snail	lumaca	2.70	2.95	0	2.08	2.43	0.90	1	0	3	6	6	949	525
snake	serpente	3.55	1.41	3	2.71	2.38	0.95	1	1	3	8	8	958	577
sofa	divano	2.28	4.41	9	3.86	3.43	1.00	1	1	3	6	6	901	563
spider	ragno	3.15	3.82	0	3.24	2.48	0.90	7	2	2	5	5	1165	547
spoon	cucchiaio	1.90	5.00	1	4.57	1.71	1.00	1	1	3	7	9	924	575
star	stella	1.00	3.82	9	3.76	1.86	1.00	3	1	2	5	6	879	632
stool	sgabello	2.35	4.09	0	3.19	3.16	0.80	1	1	3	7	8	1176	676
strawberry	fragola	2.55	3.18	1	3.38	2.38	1.00	1	1	3	7	7	978	571
submarine	sommergibile	2.95	1.18	0	2.10	3.52	0.75	1	1	5	11	12	1249	697
swan	cigno	2.65	3.05	0	2.10	2.41	0.95	1	0	2	5	5	1152	625
syringe	siringa	3.00	1.95	0	2.90	3.14	1.00	1	1	3	7	7	952	607
table	tavolo	2.05	5.00	22	4.52	1.90	1.00	4	4	3	6	6	940	583
telephone	telefono	3.52	4.95	38	4.81	2.32	1.00	1	2	4	8	8	915	567
thimble	ditale	3.35	2.36	0	2.76	3.10	0.90	1	1	3	6	6	994	581
tie	cravatta	2.65	3.77	8	3.62	3.25	1.00	1	1	3	7	8	934	596
tiger	tigre	4.35	1.45	2	2.48	3.75	0.95	2	0	2	5	5	1181	579
toast	toast	4.00	4.41	0	3.14	3.74	0.65	0	0	1	4	5	1265	621
toaster	tostapane	3.50	4.77	0	3.90	3.67	0.85	1	0	4	9	9	1200	631
tortoise	tartaruga	3.10	2.27	0	3.57	2.95	1.00	1	2	4	9	9	906	556
towel	asciugamano	3.50	5.00	2	3.14	2.43	0.85	1	1	5	9	11	1033	622
train	treno	3.45	3.59	29	4.29	2.05	1.00	3	1	2	5	5	971	562
tree	albero	3.45	5.00	17	4.81	1.71	0.90	1	1	3	6	6	1017	536
trousers	pantaloni	2.30	4.95	13	3.71	2.11	0.80	1	1	4	9	9	948	541

trumpet	tromba	3.15	2.27	1	2.52	2.67	0.90	1	1	2	6	6	936	586
umbrella	ombrello	2.95	3.77	3	3.43	2.24	1.00	1	1	3	7	8	816	533
vase	vaso	3.40	4.23	4	3.07	2.24	1.00	4	0	2	4	4	1014	554
waistcoat	gile'	2.80	3.05	0	3.76	3.53	0.80	0	3	2	4	4	1247	672
well	pozzo	3.82	1.86	10	2.24	2.90	0.95	2	1	2	4	5	1119	577
wheel	ruota	3.35	3.41	6	3.12	1.90	0.95	1	2	2	5	5	952	556
wheelbarrow	carriola	2.40	2.27	0	2.52	2.67	0.90	1	1	4	7	8	1247	565
zebra	zebra	4.30	1.32	0	1.95	2.83	1.00	1	1	2	5	5	1003	612

APPENDIX 3

Items Used in Experiment 7 (Gender Categorisation)

Italian name (English name)	Vis. comp.	Gramm. gender	Gender transp.	Gender agree't	Name agree't	AoA	Written word freq.	Rated freq	No. syll's	No. phon's	Gender categ'n RT	Naming RT
ago (needle)	1.55	M	T	0.50	0.90	2.21	1.0	3.14	2	3	1022	1168
albero (tree)	3.45	M	T	0.83	0.90	1.71	18.0	4.29	3	6	996	1017
ancora (anchor)	2.30	F	T	0.89	1.00	2.81	1.0	2.62	3	6	862	963
anello (ring)	2.55	M	T	0.50	1.00	2.62	7.0	2.95	3	5	1073	1113
aquila (eagle)	4.18	F	T	0.39	0.80	2.90	4.5	2.33	3	6	1193	1247
arancia (orange)	2.12	F	T	0.83	0.75	2.48	7.0	4.05	3	7	809	1304
arco (bow [weapon])	2.15	M	T	0.78	1.00	2.33	13.0	2.86	2	5	943	968
ascia (axe)	1.85	F	T	0.72	0.75	3.21	1.0	2.19	2	3	999	1046
asciugamano (towel)	3.50	M	T	0.94	0.85	2.43	3.0	4.81	5	9	866	1033
asino (donkey)	3.10	M	T	0.89	0.95	2.10	1.0	2.81	3	5	1011	1132
asparago (asparagus)	3.32	M	T	0.61	0.85	4.14	1.0	2.90	4	8	1018	1433
banana (banana)	1.25	F	T	0.94	1.00	2.00	1.0	4.05	3	6	750	807
bandiera (flag)	2.00	F	T	1.00	1.00	3.06	9.0	3.10	3	8	765	926
berretto (cap)	2.18	M	T	1.00	0.75	2.95	1.0	2.81	3	6	902	1171
bicchiere (glass)	1.95	M	O	1.00	1.00	1.86	11.0	4.43	3	7	797	850
bicicletta (bicycle)	3.85	F	T	0.94	1.00	1.95	9.5	4.04	4	9	750	787
bilancia (scales)	3.10	F	T	0.89	1.00	2.86	5.5	4.28	3	8	844	1034
bottiglia (bottle)	1.40	F	T	1.00	1.00	1.71	9.0	4.81	3	7	808	940
bottone (button)	2.02	M	O	0.94	0.95	2.19	3.5	2.76	3	6	921	927
braccio (arm)	1.80	M	T	0.78	0.90	1.67	28.5	4.62	2	6	1138	1029
brocca (jug)	1.85	F	T	0.83	0.75	3.00	2.0	3.10	2	5	791	1087
busta (envelope)	1.40	F	T	0.94	0.70	2.86	5.0	4.14	2	5	871	1060
cacciavite (screwdriver)	1.90	M	O	0.83	0.70	3.67	1.0	2.71	4	9	1073	1249
campana (bell)	2.55	F	T	0.94	0.90	2.81	2.0	3.69	3	7	863	928

cane (dog)	2.70	M	O	0.94	1.00	1.81	47.5	2.19	2	4	825	938
canguro (kangaroo)	3.70	M	T	0.94	1.00	3.81	1.0	2.86	3	7	786	974
cannone (cannon)	3.70	M	O	0.94	0.95	2.71	2.0	3.16	3	6	939	1001
cappello (hat)	2.15	M	T	0.94	1.00	2.44	9.0	3.00	3	6	773	837
carota (carrot)	2.65	F	T	0.89	1.00	2.71	2.0	3.95	3	6	754	868
carriola (wheelbarrow)	2.40	F	T	0.72	0.90	2.67	1.0	2.52	4	7	873	1247
carrozzina (pram)	3.55	F	T	0.83	0.75	2.44	1.0	2.76	4	8	1064	1045
catena (chain)	2.50	F	T	0.78	0.95	3.00	19.5	2.90	3	6	993	991
cavallo (horse)	3.45	M	T	0.89	1.00	1.80	32.0	2.48	3	6	859	889
chiave (key)	2.05	F	O	1.00	1.00	2.29	15.5	4.52	2	5	769	922
chiesa (church)	3.75	F	T	0.83	0.90	2.71	62.0	3.86	2	5	897	1092
chitarra (guitar)	3.10	F	T	1.00	1.00	2.28	1.0	3.19	3	6	812	863
cigno (swan)	2.65	M	T	1.00	0.95	2.41	1.0	3.19	2	5	812	1152
ciliegia (cherry)	1.60	F	T	0.78	0.85	2.57	1.5	3.00	4	7	951	1140
cintura (belt)	1.70	F	T	0.94	0.75	2.22	3.0	3.76	3	7	896	1026
cipolla (onion)	2.85	F	T	0.67	0.95	2.30	1.0	4.19	3	6	1137	1186
coccinella (ladybird)	2.35	F	T	0.94	0.95	2.89	1.0	2.38	4	8	818	1207
collana (necklace)	1.78	F	T	1.00	0.95	2.45	3.0	3.68	3	6	760	943
coltello (knife)	1.95	M	T	1.00	1.00	2.00	6.5	2.14	3	7	881	914
conchiglia (shell)	3.90	F	T	0.94	0.95	2.76	1.5	3.52	3	9	770	1114
coniglio (rabbit)	2.65	M	T	0.89	1.00	3.00	1.0	2.14	3	8	1000	940
corona (crown)	3.75	F	T	0.78	1.00	2.24	10.5	2.33	3	6	885	1074
cravatta (tie)	2.65	F	T	0.94	1.00	3.25	8.5	3.62	3	7	866	934
cucchiaio (spoon)	1.90	M	T	0.50	1.00	1.71	2.0	3.24	3	7	1084	924
cuore (heart)	1.05	M	O	0.89	1.00	2.19	62.0	4.00	2	5	886	787
diamante (diamond)	3.10	M	O	0.94	0.90	3.05	1.0	4.33	4	8	939	1099
ditale (thimble)	3.35	M	O	0.72	0.90	3.10	1.0	2.76	3	6	891	994
dito (finger)	2.35	M	T	0.94	0.75	1.80	10.5	4.38	2	4	880	1053
divano (sofa)	2.28	M	T	0.72	1.00	3.43	10.0	2.19	3	6	915	901
drago (dragon)	4.40	M	T	0.22	0.95	2.29	1.0	1.90	2	5	1111	1048
elefante (elephant)	4.12	M	O	0.89	1.00	2.48	3.5	4.14	4	8	867	847
elicottero (helicopter)	4.20	M	T	0.78	0.95	2.63	1.0	3.38	5	9	863	860
farfalla (butterfly)	4.05	F	T	0.94	1.00	2.29	2.5	3.43	3	7	758	856

finestra (window)	3.40	F	T	0.72	0.95	1.76	30.0	4.19	3	8	1022	1262
fiocco (bow [ribbon])	2.30	M	T	0.94	1.00	2.62	1.5	2.57	2	4	1001	917
fiore (flower)	2.80	M	O	0.94	0.95	2.19	13.0	3.86	2	5	899	973
fisarmonica (accordion)	4.68	F	T	0.78	1.00	3.19	1.0	2.24	5	11	911	1103
foca (seal)	2.90	F	T	0.89	0.85	2.95	1.0	2.19	2	4	949	1082
foglia (leaf)	2.75	F	T	0.94	0.90	2.06	9.0	3.24	2	6	819	993
forchetta (fork)	2.20	F	T	0.89	1.00	2.00	1.0	4.81	2	7	840	857
formaggio (cheese)	2.00	M	T	0.89	0.70	2.10	5.0	4.57	3	8	918	884
formica (ant)	3.70	F	T	0.72	0.85	2.05	1.5	3.48	3	7	1041	1263
fragola (strawberry)	2.55	F	T	0.83	1.00	2.38	2.0	3.38	3	7	912	978
frigorifero (fridge)	2.40	M	T	0.72	0.95	2.37	1.0	4.67	5	11	902	917
fungo (mushroom)	3.12	M	T	0.94	1.00	3.05	1.5	2.95	2	5	823	912
gamba (leg)	2.15	F	T	0.33	0.80	1.62	16.5	4.24	2	5	943	1094
gatto (cat)	2.60	M	T	0.89	1.00	1.43	32.5	4.19	2	4	812	884
gile (waistcoat)	2.80	M	O	0.89	0.80	3.53	1.0	3.76	2	4	1017	1247
giraffa (giraffe)	4.35	F	T	0.89	1.00	2.43	1.0	2.08	3	6	724	898
gonna (skirt)	3.15	F	T	1.00	1.00	2.38	3.5	3.90	1	4	878	892
granchio (crab)	3.75	M	T	0.94	1.00	3.00	1.0	3.00	2	7	921	1149
infermiera (nurse)	4.30	F	T	0.89	0.90	3.29	4.5	3.24	4	10	906	1038
lavagna (blackboard)	2.85	F	T	0.78	0.95	2.25	2.5	4.62	3	7	941	1052
leone (lion)	3.25	M	O	0.78	1.00	3.10	4.5	2.62	3	5	978	948
letto (bed)	2.45	M	T	0.94	1.00	1.50	83.5	4.86	2	4	983	851
libro (book)	2.45	M	T	0.89	1.00	2.25	24.0	4.86	2	5	811	876
limone (lemon)	1.30	M	O	0.72	1.00	2.60	8.0	3.90	3	6	1083	884
lumaca (snail)	2.70	F	T	1.00	0.90	2.43	1.0	2.08	3	6	718	949
luna (moon)	1.05	F	T	0.83	1.00	2.00	18.0	3.76	2	4	841	912
maiale (pig)	2.70	M	O	0.83	0.90	2.35	3.0	3.03	3	6	1095	1173
martello (hammer)	2.55	M	T	0.94	1.00	2.44	5.0	4.90	3	7	870	924
matita (pencil)	2.05	F	T	0.89	0.95	2.29	1.0	4.38	3	6	876	1042
mela (apple)	1.75	F	T	0.83	1.00	1.67	11.0	4.29	2	4	772	994
montagna (mountain)	2.30	F	T	0.78	0.80	2.14	23.0	3.71	3	8	937	1112
mosca (fly)	3.55	F	T	0.67	0.90	2.06	4.0	3.71	2	5	915	1251
motocicletta (motorbike)	4.15	F	T	0.72	0.85	2.57	8.5	3.67	5	11	973	994

mucca (cow)	3.85	F	T	0.89	1.00	2.32	1.0	3.14	2	4	867	1085
naso (nose)	1.35	M	T	1.00	0.95	1.86	20.5	3.43	2	4	892	995
nuvola (cloud)	1.15	F	T	0.83	1.00	2.10	5.5	3.57	3	6	1007	941
occhio (eye)	3.48	M	T	0.94	0.95	1.67	29.0	4.38	2	4	875	845
ombrello (umbrella)	2.95	M	T	0.89	1.00	2.24	4.0	4.81	3	7	1036	816
orecchio (ear)	2.85	M	T	0.89	0.95	1.71	10.0	4.19	3	6	903	875
orologio (clock)	3.90	M	T	0.89	0.75	3.10	11.5	4.43	1	5	1125	1141
orologio (watch)	2.95	M	T	0.78	1.00	2.57	11.5	3.07	4	7	993	903
orso (bear)	3.40	M	T	0.94	0.95	2.26	8.5	2.71	2	4	898	1029
palla (ball)	2.25	F	T	0.78	0.80	1.74	9.5	4.24	2	4	789	964
pallone (balloon)	1.25	M	O	0.72	0.85	1.83	4.5	2.24	3	6	994	1113
pane (bread)	1.50	M	O	0.89	0.90	1.62	36.0	4.86	2	4	910	1116
paracadute (parachute)	2.40	M	O	0.72	0.95	3.33	1.0	2.29	5	10	1075	1258
patata (potato)	2.20	F	T	0.94	0.85	2.42	1.5	3.95	3	6	850	1163
pavone (peacock)	4.25	M	O	0.94	1.00	2.71	1.0	2.38	3	6	1002	1074
pecora (sheep)	3.30	F	T	0.94	0.90	2.20	2.0	2.95	3	6	1002	1210
peperone (pepper)	2.48	M	O	0.94	0.95	2.95	1.0	3.52	4	8	900	1204
pera (pear)	1.20	F	T	1.00	1.00	2.19	1.0	3.86	2	4	815	853
pesce (fish)	2.95	M	O	1.00	1.00	2.14	13.0	2.52	2	4	839	873
pettine (comb)	2.00	M	O	0.89	1.00	2.22	1.0	2.33	3	6	844	907
piede (foot)	1.85	M	O	0.78	1.00	1.71	1.0	3.76	3	5	1023	808
pinguino (penguin)	2.60	M	T	0.94	0.95	2.62	1.0	1.95	3	8	1111	968
pipa (pipe)	1.95	F	T	0.83	1.00	3.11	5.0	2.43	2	4	1019	825
pistola (gun)	2.75	F	T	0.78	0.90	2.71	6.0	2.81	3	7	906	835
porta (door)	2.65	F	T	1.00	1.00	2.21	21.5	4.71	2	5	773	816
pozzo (well)	3.82	M	T	0.83	0.95	2.90	11.0	4.53	2	4	825	1119
proiettile (bullet)	2.70	M	O	0.83	0.95	3.19	1.0	4.95	4	8	914	1338
ragno (spider)	3.15	M	T	0.72	0.90	2.48	1.0	3.86	2	5	1022	1165
rana (frog)	3.60	F	T	0.89	0.95	2.35	1.0	2.08	2	4	769	908
rinoceronte (rhinoceros)	4.15	M	O	0.89	0.95	2.71	1.0	2.19	5	11	888	994
roulotte (caravan)	3.20	F	O	0.67	0.80	3.67	1.0	2.76	2	5	1033	1162
ruota (wheel)	3.35	F	T	0.89	0.95	1.90	6.5	3.12	2	5	770	952
scala (ladder)	2.55	F	T	0.94	0.85	2.10	14.0	4.14	2	5	944	1096

scarpa (shoe)	3.20	F	T	1.00	1.00	1.62	16.5	4.52	3	6	687	980
scialle (shawl)	3.70	M	O	0.72	0.80	3.86	2.0	2.57	2	4	938	1192
scimmia (monkey)	3.20	F	T	0.94	0.85	2.22	1.0	2.02	3	5	776	1121
scivolo (slide)	3.95	M	T	0.83	0.95	2.33	1.0	3.71	3	6	1030	1164
scopa (broom)	2.45	F	T	0.94	0.95	2.05	1.0	3.08	2	5	804	973
scrivania (desk)	3.30	F	T	0.72	0.75	2.78	4.0	3.29	4	9	988	1096
sedia (chair)	2.10	F	T	1.00	1.00	1.86	10.0	4.86	3	5	721	830
sega (saw)	2.25	F	T	1.00	0.85	3.10	1.0	2.48	2	4	913	1200
serpente (snake)	3.55	M	O	0.78	0.95	2.38	3.5	2.71	3	8	1065	958
sgabello (stool)	2.35	M	T	0.89	0.80	3.16	1.0	4.57	3	7	812	1176
sigaretta (cigarette)	2.10	F	T	1.00	0.90	2.72	16.0	4.52	4	8	952	949
siringa (syringe)	2.95	F	T	1.00	0.75	3.52	1.0	2.90	5	11	835	1249
sottomarino (submarine)	2.95	M	O	0.89	0.75	3.52	1.0	2.10	5	11	968	1249
spazzola (brush)	2.60	F	T	1.00	1.00	2.95	1.0	4.38	3	7	753	1079
stella (star)	1.00	F	T	1.00	1.00	1.86	9.5	3.76	2	5	789	879
stivale (boot)	2.05	M	O	0.22	0.75	2.63	1.5	3.29	3	7	1305	1117
struzzo (ostrich)	3.15	M	T	0.94	0.90	3.00	1.0	4.38	2	6	876	1377
tamburo (drum)	2.65	M	T	0.94	0.85	3.05	1.0	2.29	4	7	888	1101
tartaruga (tortoise)	3.10	F	T	0.83	1.00	2.95	1.0	3.57	4	9	891	906
tavolo (table)	2.05	M	T	0.56	1.00	1.90	23.0	2.10	3	6	967	940
telefono (telephone)	3.52	M	T	0.94	1.00	2.32	38.5	4.52	4	8	877	915
tigre (tiger)	4.35	F	O	0.78	0.95	3.75	2.5	2.48	2	5	793	1181
topo (mouse)	3.00	M	T	0.89	0.90	2.48	3.5	2.48	2	4	953	935
torcia (torch)	3.25	F	T	0.50	1.00	2.16	2.5	3.71	2	5	1159	888
tostapane (toaster)	3.50	M	O	0.78	0.85	3.67	1.0	3.90	4	9	1074	1200
treno (train)	3.45	M	T	0.89	1.00	2.05	30.0	3.14	2	5	855	971
tromba (trumpet)	3.15	F	T	0.89	0.90	2.67	2.0	2.52	2	6	863	936
unghia (nail, f)	1.85	F	T	0.89	0.90	2.71	2.0	4.71	2	5	872	1132
uva (grapes)	3.35	F	T	0.83	0.95	2.19	16.0	3.38	2	3	986	991
vaso (vase)	3.40	M	T	0.78	1.00	2.24	5.0	3.43	2	4	998	1014
vestito (dress)	3.45	M	T	0.94	0.85	2.86	8.5	4.62	3	7	781	1091
vite (screw)	2.90	F	O	0.50	0.70	2.94	1.0	3.14	2	4	1080	1181
zebra (zebra)	4.30	F	T	0.78	1.00	2.83	1.0	1.95	2	5	842	1003

zucca (pumpkin)	2.60	F	T	1.00	0.95	2.63	1.5	2.76	2	4	772	1357

Vis. comp. = Visual complexity, Gramm. gender = Grammatical gender (M = masculine, F = feminine), Gender transp. = Gend[illegible] transparency (T = transparent, C = Opaque), Gender agree't = Gender agreement, .Name agree't = Name agreement, AoA = Age [illegible] acquisition, Written word freq. = Written word frequency, Rated freq. = rated frequency, No. syll's = Number of syllables in th[illegible] spoken name, No. Phon's = Number of phonemes in the spoken name, Gender categ'n RT = Gender categorization reaction time.

APPENDIX 4

Items Used in Experiment 8 (Gender Classification & Naming of a Matched Picture Set)

Italian name (Eng. name)	Vis. comp.	Written word freq.	Subj freq.	Gender agree't	Name agree	No. sylls
			Early acquired masculine			
asciugamano (towel)	3.50	3.0	3.14	0.94	0.85	5
asino (donkey)	3.10	1.0	2.81	0.89	0.95	3
bottone (button)	2.02	3.5	3.16	0.94	0.95	3
cappello (hat)	2.15	9.0	3.38	0.94	1.00	3
cigno (swan)	2.65	1.0	2.10	1.00	0.95	2
coltello (knife)	1.95	6.5	4.76	1.00	1.00	3
maiale (pig)	2.70	3.0	3.03	0.83	0.90	3
martello (hammer)	2.55	5.0	3.00	0.94	1.00	3
ombrello (umbrella)	2.95	4.0	3.43	0.89	1.00	3
orecchio (ear)	2.85	10.0	4.19	0.89	0.95	3
orso (bear)	3.40	8.5	2.71	0.94	0.95	2
pettine (comb)	2.00	1.0	4.33	0.89	1.00	3
piede (foot)	1.85	1.0	4.43	0.78	1.00	3
scivolo (slide)	3.95	1.0	2.19	0.83	0.95	3
serpente (snake)	3.55	3.5	2.71	0.78	0.95	3
vaso (vase)	3.40	5.0	3.07	0.78	1.00	2
M	2.79	4.13	3.28	0.89	0.96	2.94
SD	0.66	3.02	0.78	0.07	0.04	0.68
			Early acquired feminine			
bicicletta (bicycle)	3.85	9.50	4.04	0.94	1.00	4
bottiglia (bottle)	1.40	9.0	4.81	1.00	1.00	3
chitarra (guitar)	3.10	1.0	3.19	1.00	1.00	3
farfalla (butterfly)	4.05	2.5	3.43	0.94	1.00	3
foglia (leaf)	2.75	9.0	3.24	0.94	0.90	2
forchetta (fork)	2.20	1.0	4.81	0.89	1.00	2
fragola (strawberry)	2.55	2.0	3.08	0.83	1.00	3
giraffa (giraffe)	4.35	1.0	2.08	0.89	1.00	3
lavagna (blackboard)	2.85	2.5	3.01	0.78	0.95	3
lumaca (snail)	2.70	1.0	2.08	1.00	0.90	3
rana (frog)	3.60	1.0	2.08	0.89	0.95	2
ruota (wheel)	3.35	6.5	3.12	0.89	0.95	2
scimmia (monkey)	3.20	1.0	2.02	0.94	0.85	3
scopa (broom)	2.45	1.0	3.08	0.94	0.95	2
sedia (chair)	2.10	10.0	4.86	1.00	1.00	3
stella (star)	1.00	9.5	3.76	1.00	1.00	2
M	2.84	4.22	3.29	0.93	0.97	2.69
SD	0.91	3.86	0.97	0.07	0.05	0.60

		Late acquired masculine				
canguro (kangaroo)	3.70	1.0	2.14	0.94	1.00	3
cannone (cannon)	3.70	2.0	2.33	0.94	0.95	3
elefante (elephant)	4.12	3.5	2.52	0.89	1.00	4
fiocco (bow [ribbon])	2.30	1.5	2.57	0.94	1.00	2
fungo (mushroom)	3.12	1.5	3.14	0.94	1.00	2
gilé (waistcoat)	2.80	1.0	3.76	0.89	0.80	2
leone (lion)	3.25	4.5	2.62	0.78	1.00	3
occhiali (glasses)	2.60	8.5	4.57	0.94	1.00	3
orologio (watch)	2.95	11.5	4.53	0.78	1.00	4
piattini (cymbals)	4.25	1.0	3.90	0.94	0.80	3
pozzo (well)	3.82	11.0	2.24	0.83	0.95	2
proiettile (bullet)	2.70	2.0	2.76	0.83	0.95	4
sci (ski)	3.05	5.0	2.86	0.78	0.95	2
sgabello (stool)	2.35	1.0	3.19	0.89	0.80	3
tostapane (toaster)	3.50	1.0	3.90	0.78	0.85	4
vestito (dress)	3.45	8.5	4.62	0.94	0.85	3
M	3.23	4.03	3.23	0.88	0.93	2.94
SD	0.60	3.77	0.87	0.07	0.08	0.77
		Late acquired feminine				
ancora (anchor)	2.30	1.0	2.62	0.89	1.00	3
bandiera (flag)	2.00	10.0	3.10	1.00	1.00	3
bilancia (scales)	3.10	5.5	4.28	0.89	1.00	3
campana (bell)	2.55	2.0	3.69	0.94	0.90	3
ciliegia (cherry)	1.60	1.5	3.00	0.78	0.85	4
collana (neclace)	1.78	3.0	3.68	1.00	0.95	3
conchiglia (shell)	3.90	1.5	3.52	0.94	0.95	3
cravatta (tie)	2.65	8.5	3.62	0.94	1.00	3
fisarmonica (accordion)	4.68	1.0	2.24	0.78	1.00	5
infermiera (nurse)	4.30	4.5	3.24	0.89	0.90	4
pipa (pipe)	1.95	5.0	3.43	0.83	1.00	2
pistola (gun)	2.75	6.0	2.81	0.78	0.90	3
sega (saw)	2.25	1.0	2.48	1.00	0.85	2
tigre (tiger)	4.35	2.5	2.48	0.78	0.95	2
tromba (trumpet)	3.15	2.0	2.52	0.89	0.90	2
unghia (fingernail)	1.85	2.0	4.71	0.89	0.90	2
M	2.82	3.56	3.21	0.89	0.94	2.94
SD	1.00	2.77	0.69	0.08	0.06	0.85

Vis. comp. = Visual complexity, freq. = frequency, agree = agreement, no. sylls = number of syllables.

APPENDIX 5

Items Used in Experiments 11 and 12 (Cognate and Non-Cognate Priming)

VComp = Visual Complexity
Wr Freq = Written Frequency

Fam = Familiarity
R AoA = Rated Age of Acquisition

NAgree = Name Agreement
Sylls = Syllable Length

Phons = Phoneme Length

ITALIAN COGNATES

English Translation	Italian Item	VComp	Fam	Wr Freq	Rated AoA	NAgree	Phons	Sylls
anchor	ancora	2.30	1.68	1.00	2.81	1.00	6	3
asparagus	asparago	3.32	2.91	1.00	4.14	0.85	8	4
cigarette	sigaretta	2.10	4.82	16.00	2.72	0.90	8	4
diamond	diamante	3.10	1.64	1.00	3.05	0.90	8	4
banana	banana	1.25	4.23	1.00	2.00	1.00	6	3
bicycle	bicicletta	3.85	4.73	9.50	1.95	1.00	9	4
bottle	bottiglia	1.40	4.95	9.00	1.71	1.00	7	3
button	bottone	2.02	4.82	3.50	2.19	0.95	6	3
cactus	cactus	2.15	2.50	1.00	3.67	1.00	6	2
candle	candela	2.25	3.55	2.00	2.25	1.00	7	3
cannon	cannone	3.70	1.50	2.00	2.71	0.95	6	3
carrot	carota	2.65	4.14	2.00	2.71	1.00	6	3
cat	gatto	2.60	4.18	32.50	1.43	1.00	4	2
dragon	drago	4.40	1.45	1.00	2.29	0.95	5	2
elephant	elefante	4.12	1.41	3.50	2.48	1.00	8	4
giraffe	giraffa	4.35	1.32	1.00	2.43	1.00	6	3
gorilla	gorilla	3.20	1.41	1.00	2.57	0.80	6	3
kangaroo	canguro	3.70	1.23	1.00	3.81	1.00	7	3
lemon	limone	1.30	4.50	8.00	2.60	1.00	6	3
lion	leone	3.25	1.59	4.50	3.10	1.00	5	3
motorbike	motocicletta	4.15	4.36	8.50	2.57	0.85	11	5
mountain	montagna	2.30	2.59	23.00	2.14	0.80	8	3
harp	arpa	3.70	1.73	1.00	3.19	1.00	4	2
pear	pera	1.20	3.82	1.00	2.19	1.00	4	2
penguin	pinguino	2.60	1.27	1.00	2.62	0.95	8	3
pipe	pipa	1.95	2.59	5.00	3.11	1.00	4	2
potato	patata	2.20	4.32	1.50	2.42	0.85	6	3
rhinoceros	rinoceronte	4.15	1.27	1.00	2.71	0.95	11	5
shawl	scialle	3.70	2.59	2.00	3.86	0.80	4	2
helicopter	elicottero	4.20	2.27	1.00	2.63	0.95	9	5
syringe	siringa	3.00	1.95	1.00	3.14	1.00	7	3
train	treno	3.45	3.59	30.00	2.05	1.00	5	2
telephone	telefono	3.52	4.95	38.50	2.32	1.00	8	4
tiger	tigre	4.35	1.45	2.50	3.75	0.95	5	2
toast	toast	4.00	4.41	1.00	3.74	0.65	4	1

trumpet	tromba	3.15	2.27	2.00	2.67	0.90	6	2
umbrella	ombrello	2.95	3.77	4.00	2.24	1.00	7	3
vase	vaso	3.40	4.23	5.00	2.24	1.00	4	2
zebra	zebra	4.30	1.32	1.00	2.83	1.00	5	2
clown	clown	3.90	1.64	7.74	3.10	0.75	5	1
dentist	dentista	4.05	2.09	7.47	2.94	0.95	8	3
doctor	dottore	4.35	2.55	7.63	1.95	0.80	5	3
mean		3.13	2.85	6.06	2.69	0.94	6.38	2.90
min		1.20	1.23	1.00	1.43	0.65	4.00	1.00
max		4.40	4.95	38.50	4.14	1.00	11.00	5.00
std dev		0.96	1.32	9.00	0.62	0.09	1.81	0.96

ITALIAN NON-COGNATES

English Translation	Italian Item	VComp	Famil	Wr Freq	Rated AoA	NAgree	Phons	Sylls
trousers	pantaloni	2.30	4.95	13.50	2.11	0.80	9	4
sheep	pecora	3.30	2.82	2.00	2.20	0.90	6	3
lorry	camion	2.25	4.41	7.00	2.79	0.95	6	3
crab	granchio	3.75	1.86	1.00	3.00	1.00	7	2
envelope	busta	1.40	4.64	5.00	2.86	0.70	5	2
cow	mucca	3.85	3.09	1.00	2.32	1.00	4	2
finger	dito	2.35	5.00	11.00	1.80	0.75	4	2
flag	bandiera	2.00	3.27	9.00	3.06	1.00	8	3
bell	campana	2.55	2.86	2.00	2.81	1.00	7	3
fork	forchetta	2.20	1.41	3.50	2.00	1.00	7	2
ant	formica	3.70	3.64	1.50	2.05	0.85	7	3
leaf	foglia	2.75	4.27	9.00	2.06	0.90	6	2
glasses	occhiali	2.60	4.95	8.50	2.57	1.00	6	3
accordion	fisarmonica	4.68	1.77	1.00	3.19	1.00	11	5
eagle	aquila	4.18	1.64	4.50	2.90	0.80	6	3
fly	mosca	3.55	4.41	4.00	2.06	0.90	5	2
guitar	chitarra	3.10	3.55	1.00	2.28	1.00	6	3
king	re	3.70	1.32	77.00	2.38	1.00	2	3
cherry	ciliegia	1.60	2.50	1.50	2.57	0.85	7	4
lightbulb	lampadina	3.25	4.95	2.50	2.16	1.00	9	4
bus	autobus	4.15	4.77	1.00	2.71	0.70	7	3
comb	pettine	2.00	4.73	1.00	2.22	1.00	6	3
bread	pane	1.50	4.95	36.00	1.62	0.90	4	2
apple	mela	1.75	4.64	11.00	1.67	1.00	4	2
brush	spazzola	2.60	3.91	1.00	2.95	1.00	7	3
belt	cintura	1.70	4.64	3.00	2.22	0.75	7	3
cap	berretto	2.18	3.55	1.00	2.95	0.75	6	3
lobster	aragosta	4.25	1.95	1.00	3.33	0.65	8	4
slide	scivolo	3.95	2.50	1.00	2.33	0.95	6	3
donkey	asino	3.10	1.91	1.00	2.10	0.95	5	3
cake	torta	2.80	3.82	4.00	1.67	1.00	5	2

boot	stivale	2.05	4.32	1.50	2.63	0.75	7	3
caravan	roulotte	3.20	2.50	1.00	3.67	0.80	5	2
nurse	infermiera	4.30	2.05	4.50	3.29	0.90	10	4
butterfly	farfalla	4.05	3.14	2.50	2.29	1.00	7	3
scales	bilancia	3.10	4.00	5.50	2.86	1.00	8	3
onion	cipolla	2.85	4.36	1.00	2.30	0.95	6	3
bear	orso	3.40	1.23	8.50	2.26	0.95	4	2
peacock	pavone	4.25	1.91	1.00	2.71	1.00	6	3
pram	carrozzina	3.55	3.23	1.00	2.44	0.75	8	4
scarecrow	spaventapasseri	4.30	1.86	1.00	3.10	0.75	14	6
cymbals	piattini	4.25	1.64	1.00	3.37	0.80	7	3
mean		3.06	3.31	6.07	2.52	0.90	6.55	2.98
min		1.40	1.23	1.00	1.62	0.65	2.00	2.00
max		4.68	5.00	77.00	3.67	1.00	14.00	6.00
std dev		0.93	1.25	12.74	0.50	0.11	2.09	0.87

ENGLISH COGNATES

English Item	Italian Translation	VComp	Famil	Wr Freq	Rated AoA	NAgree	Phons	Sylls
anchor	ancora	2.30	1.73	5.00	3.35	1.00	4	2
asparagus	asparago	3.32	2.14	1.00	5.90	0.59	9	4
cigarette	sigaretta	2.10	3.86	52.00	3.35	1.00	7	3
diamond	diamante	3.10	1.65	8	3.80	0.65	6	2
banana	banana	1.25	3.71	4.00	1.80	0.91	6	3
bicycle	bicicletta	3.85	4.09	8.00	2.40	0.64	3	1
bottle	bottiglia	1.40	4.41	88.00	2.10	0.96	4	2
button	bottone	2.02	4.09	16.00	2.05	1.00	4	2
cactus	cactus	2.15	2.70	2.00	3.75	1.00	6	2
candle	candela	2.25	3.32	8.00	2.80	1.00	5	2
cannon	cannone	3.70	1.64	3.00	3.85	1.00	5	2
carrot	carota	2.65	4.23	3.00	2.05	1.00	5	2
cat	gatto	2.60	4.00	44.00	1.50	1.00	3	1
dragon	drago	4.40	2.35	8.00	2.25	1.00	5	2
elephant	elefante	4.12	2.18	6.00	2.05	1.00	7	3
giraffe	giraffa	4.35	1.55	1.00	2.30	0.96	5	2
gorilla	gorilla	3.20	1.64	2.00	2.85	0.86	6	3
kangaroo	canguro	3.70	1.41	1.00	3.05	0.96	7	3
lemon	limone	1.30	2.95	14.00	2.40	1.00	5	2
lion	leone	3.25	1.91	9.00	1.75	1.00	4	2
motorbike	motocicletta	4.15	3.32	1.00	3.00	0.85	7	3
mountain	montagna	2.30	2.41	49.00	2.95	0.90	6	2
harp	arpa	3.70	1.68	3	4.00	1.00	3	1
pear	pera	1.20	3.23	3.00	2.35	1.00	2	1
penguin	pinguino	2.60	1.86	4.00	3.05	0.91	7	2
pipe	pipa	1.95	2.18	22.00	2.70	1.00	3	1
potato	patata	2.20	3.91	12.00	2.10	0.82	6	3

rhinoceros	rinoceronte	4.15	1.64	1.00	3.30	0.67	9	4
shawl	scialle	3.70	2.30	5.00	4.30	0.90	3	1
helicopter	elicottero	4.20	2.00	11	3.00	0.82	9	4
syringe	siringa	3.00	2.50	1.00	4.80	0.80	6	2
train	treno	3.45	3.64	65	2.40	0.95	4	1
telephone	telefono	3.52	4.36	100.00	2.20	0.64	7	3
tiger	tigre	4.35	1.77	5.00	2.10	0.80	4	2
toast	toast	4.00	3.70	15.00	1.75	0.95	4	1
trumpet	tromba	3.15	2.05	5.00	3.10	0.96	7	2
umbrella	ombrello	2.95	3.41	12.00	2.65	0.96	7	3
vase	vaso	3.40	2.50	4.00	3.25	1.00	3	1
zebra	zebra	4.30	1.41	1.00	2.50	1.00	5	2
clown	clown	3.90	2.09	3.00	2.35	1.00	4	1
dentist	dentista	4.05	2.95	7.00	2.90	1.00	7	2
doctor	dottore	4.35	3.65	136.00	2.75	0.95	5	2
mean		3.13	2.72	17.81	2.83	0.91	5.33	2.12
min		1.20	1.41	1.00	1.50	0.59	2.00	1.00
max		4.40	4.41	136.00	5.90	1.00	9.00	4.00
std dev		0.96	0.96	29.79	0.88	0.12	1.76	0.86

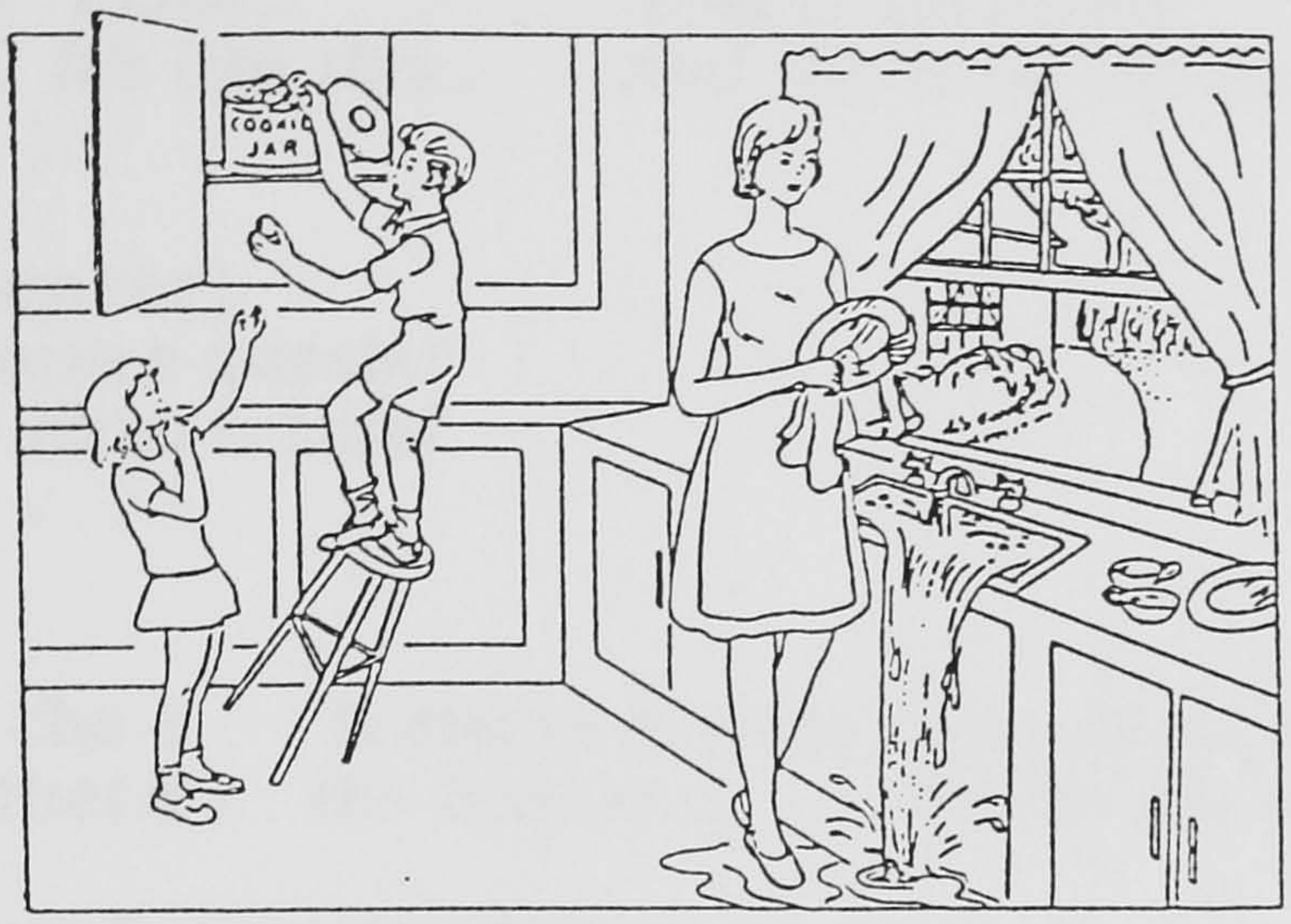
ENGLISH NON-COGNATES

English Item	Italian Translation	VComp	Famil	Wr Freq	Rated AoA	NAgree	Phons	Sylls
trousers	pantaloni	2.30	4.90	29.00	1.70	1.00	6	2
sheep	pecora	3.30	2.86	21.00	1.90	0.96	3	1
lorry	camion	2.25	3.41	8.00	2.10	0.75	4	2
crab	granchio	3.75	2.55	5.00	2.70	1.00	4	1
envelope	busta	1.40	4.30	20.00	3.45	0.96	7	3
cow	mucca	3.85	3.18	23.00	1.95	1.00	2	1
finger	dito	2.35	2.22	51.00	1.65	1.00	5	2
flag	bandiera	2.00	2.22	10.00	3.20	1.00	4	1
chair	campana	2.55	2.50	27.00	2.40	1.00	3	1
gun	pistola	2.75	2.00	67.00	2.75	0.85	3	1
ant	formica	3.70	2.75	4.00	2.30	0.86	3	1
leaf	foglia	2.75	3.41	16.00	2.05	1.00	3	1
glasses	occhiali	2.60	3.82	34.00	2.80	0.86	6	2
accordion	fisarmonica	4.68	1.62	1.00	4.65	0.68	8	4
eagle	aquila	4.18	2.05	8.00	3.20	0.64	4	2
fly	mosca	3.55	3.23	18.00	2.15	0.96	3	1
spider	spider	3.15	3.09	4.00	2.26	0.95	5	2
king	re	3.70	3.00	93.00	2.10	0.96	3	1
cherry	ciliegia	1.60	2.43	5.00	2.80	0.95	4	2
lightbulb	lampadina	3.25	4.30	1.00	3.10	0.55	7	2
pineapple	ananas	3.60	2.36	2.00	3.05	0.86	6	3
comb	pettine	2.00	3.68	4.00	2.10	1.00	3	1
bread	pane	1.50	4.68	78.00	1.70	0.96	4	1

apple	mela	1.75	4.48	19.00	1.70	1.00	3	2
brush	spazzola	2.60	3.68	13.00	2.30	0.82	4	1
belt	cintura	1.70	3.81	21.00	3.00	0.90	4	1
cap	berretto	2.18	2.91	29.00	2.90	0.91	3	1
lobster	aragosta	4.25	1.77	2.00	4.20	0.91	6	2
slide	scivolo	3.95	2.90	8.00	2.30	1.00	4	1
donkey	asino	3.10	1.95	10.00	2.25	0.91	5	2
cake	torta	2.80	3.32	22.00	1.90	1.00	3	1
boot	stivale	2.05	4.23	9.00	2.55	0.96	3	1
caravan	roulotte	3.20	2.85	6.00	3.85	1.00	7	3
nurse	infermiera	4.30	3.70	32.00	2.45	1.00	3	1
butterfly	farfalla	4.05	2.73	5.00	2.20	1.00	7	3
scales	bilancia	3.10	3.20	10.00	3.55	0.87	5	1
onion	cipolla	2.85	3.95	10.00	2.55	1.00	5	2
bear	orso	3.40	1.73	6.00	1.95	0.59	2	1
peacock	pavone	4.25	1.91	3.00	3.60	0.96	5	2
pram	carrozzina	3.55	2.40	6.00	1.75	1.00	4	1
scarecrow	spaventapasseri	4.30	2.15	1.00	3.20	1.00	6	2
cymbals	piattini	4.25	2.40	1.00	3.70	1.00	6	2
mean		3.06	3.02	17.67	2.62	0.92	4.40	1.62
min		1.40	1.62	1.00	1.65	0.55	2.00	1.00
max		4.68	4.90	93.00	4.65	1.00	8.00	4.00
std dev		0.90	0.87	20.74	0.73	0.12	1.53	0.76

APPENDIX 6

The Cookie Jar Theft Picture from the Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1972) and ED's Descriptions of it in Italian and English.



Italian

(ED)
"Eh questo è salito sopra una... non è una sedia, è una *(3sec)* come si chiama...
This one climbed onto a it isn't a chair, it's a what is it called

un tavolinetto piccol<u>a</u> e que.. e poi è andato a prendere.. questo che cos'è ?....*(5sec)*
a small table and then he went to take what's this?....

...Una palla, Che è? E questo l'ha chiesto 'dammela'. E questo qua *(2sec)* Che c'è? *..A ball, What is it? And this asked him 'give me it'. And this... what is there?*

Sta dentro una -a casa, ce ha un un cappello in mano...*(2sec)*.. e poi...*(4sec)*
She's in a-a house, she has a a hat in her hands.. and then..

Non so dire."
I can't say.

(Experimenter)
"E qui, cosa succede? [pointing to the sink] Cosa c'è per terra?"
And what is happening here? what is on the floor?

(ED)
(4sec) "Che c'è? Che c'è? É un-una..tutta.. come se avesse rotto qualche qualche cosa...
What is it? What is it? It's a- all as though she broke something....

mm...*(3sec)* É così... E lei ci sta sopra."
mm.. It's like this... And she is on top of it."

(Experimenter)
"E quale stanza e questa?"
And which room is this?

(ED)
"Io credo che è la stanza da letto. C la stanza da pranzo..*(2sec)* Si?
I believe that it's the bedroom. Or the dining room Yes?

Ho indovinato? La seconda?"
Did I guess? The second?

<u>English</u>

(ED)
"This here boy ... have a ... this ball and this girl said 'you will' ... and this lady's ... have just this house (*6sec pause)*... Come in inside and have something in the hands. Cap. And ... on the floor, all a mess."

APPENDIX 7
Items and Variables for ED's English Picture Naming

ED Pics Eng = ED's Picture Naming in English (1 = correct, 0 = incorrect)
Fam = Familiarity
OAoA = Objective Age of Acquisition
NAgree = Name Agreement
Phons = Phoneme Length
Image = Imageability
RFreq = Rated Frequency
R Freq = Rated Frequency
VComp = Visual Complexity
R AoA = Rated Age of Acquisition
CComFreq = Celex Combined Frequency
Sylls = Syllable Length

Item	ED Pics Eng	VComp	Fam	Image	R AoA	O AoA	RFreq	CComFreq	NAgree	Sylls	Phons
apple	1	1.75	4.48	6.50	1.80	20.5	3.90	1.28	1.00	2	3
arrow	0	1.60	3.27	6.30	2.85	62.5	2.20	0.95	1.00	2	3
ashtray	0	2.25	3.50	5.55	3.45	140	2.90	1.00	1.00	2	5
ball	1	2.25	3.36	6.40	1.25	26.5	3.45	1.97	0.91	1	3
banana	1	1.25	3.71	6.55	1.70	26.5	3.70	0.70	0.91	3	6
bed	1	2.45	4.86	6.55	1.25	20.5	4.70	2.39	1.00	1	3
bicycle	0	3.85	4.09	6.60	2.00	26.5	3.65	0.90	0.64	1	3
book	0	2.45	4.68	6.05	1.55	20.5	4.70	2.43	1.00	1	3
boot	1	2.05	4.23	6.05	1.90	26.5	4.15	0.95	0.96	1	3
bread	0	1.50	4.68	6.30	1.95	38.5	4.40	1.88	0.96	1	4
bus	0	4.15	3.95	6.55	1.75	26.5	3.85	1.81	0.82	1	3
butterfly	0	4.05	2.73	6.25	2.30	26.5	2.55	0.78	1.00	3	7
button	0	2.02	4.09	6.40	2.15	38.5	3.05	1.18	1.00	2	4
cake	0	2.80	3.32	6.40	1.80	26.5	3.40	1.34	1.00	1	3
camel	1	3.00	1.73	6.40	3.20	68.5	1.65	0.95	1.00	2	4
camera	0	2.70	3.95	6.00	2.90	50.5	3.35	1.40	1.00	2	5
candle	0	2.25	3.32	6.10	3.25	38.5	3.05	0.95	1.00	2	5
cannon	1	3.70	1.64	5.55	3.95	114.5	1.50	0.60	1.00	2	5
carrot	1	2.65	4.23	6.50	2.25	32.5	3.40	0.60	1.00	2	5
cat	1	2.60	4.00	6.40	1.15	26.5	3.40	1.62	1.00	1	3

chair	1	2.10	4.77	6.45	1.80	20.5	4.00	2.02	1.00	1	2
cheese	0	2.00	4.60	6.20	2.00	44.5	3.95	1.46	1.00	1	3
church	0	3.75	3.09	6.50	2.35	44.5	3.20	2.20	0.96	1	3
cigar	0	3.58	2.23	5.95	3.70	126.5	1.85	1.11	0.95	2	4
cigarette	1	2.10	3.86	6.25	3.25	86.5	3.30	1.69	1.00	3	7
clock	0	2.60	4.18	6.25	1.95	20.5	3.85	1.57	1.00	1	4
cloud	0	1.15	4.05	6.60	1.90	56.5	3.35	1.49	1.00	1	4
coat	0	2.45	3.77	5.75	1.90	68.5	4.00	1.71	1.00	1	3
comb	1	2.00	3.68	6.15	2.55	38.5	3.05	0.70	1.00	1	3
cooker	0	3.75	4.45	5.85	2.35	56.5	4.00	0.70	0.65	2	4
cow	1	3.85	3.18	6.55	1.45	26.5	2.90	1.36	1.00	1	2
crown	0	3.75	1.68	6.40	2.40	56.5	1.80	1.38	1.00	1	4
cup	1	2.05	4.59	6.50	1.50	32.5	4.60	1.78	0.96	1	3
dentist	0	4.05	2.95	6.25	2.80	86.5	2.60	0.78	1.00	2	7
dog	1	2.70	4.05	6.65	1.30	20.5	3.50	1.85	1.00	1	3
donkey	0	3.10	1.95	6.55	2.20	50.5	2.10	1.00	0.91	2	5
door	1	2.65	4.73	5.95	1.60	20.5	4.50	2.52	1.00	1	2
elephant	1	4.12	2.18	6.70	2.30	26.5	2.10	0.78	1.00	3	7
envelope	0	1.40	4.30	5.80	3.25	68.5	3.15	1.30	0.96	3	7
fish	1	2.95	3.09	6.75	1.90	20.5	3.05	1.91	1.00	1	3
flag	1	2.00	2.22	6.35	2.80	38.5	2.15	1.00	1.00	1	4
flower	1	2.80	3.27	6.90	1.70	20.5	3.00	1.45	1.00	2	4
fork	1	2.20	4.55	6.35	1.95	26.5	4.00	1.11	1.00	1	3
frog	1	3.60	2.38	6.35	2.10	26.5	2.25	0.70	0.91	1	4
giraffe	1	4.35	1.55	6.40	2.65	38.5	1.85	0.30	0.96	2	5
glass	1	1.95	4.45	6.00	2.25	44.5	4.10	2.10	0.96	1	4
glasses	1	2.60	3.82	6.25	2.40	26.5	3.85	1.52	0.86	2	6
goat	0	2.80	2.00	6.30	2.45	56.5	2.00	1.11	0.96	1	3
grapes	1	3.35	3.00	6.25	2.70	56.5	3.05	0.95	1.00	1	5
guitar	1	3.10	3.00	6.35	2.80	62.5	2.65	0.85	1.00	2	4

gun	1	2.75	2.00	6.50	2.75	44.5	2.35	1.81	0.85	1	3
hammer	1	2.55	2.82	6.10	2.55	32.5	2.25	1.00	1.00	2	4
hat	0	2.15	2.59	6.60	1.65	26.5	2.90	1.73	0.96	1	3
helicopter	1	4.20	2.00	6.35	2.70	26.5	2.00	1.08	0.82	4	9
hen	0	2.90	3.20	6.50	2.05	50.5	2.10	0.85	0.70	1	3
horse	0	3.45	2.82	6.70	1.75	26.5	2.75	1.93	1.00	1	3
house	1	2.40	3.77	6.65	1.30	20.5	4.00	2.68	1.00	1	3
iron	1	3.25	3.05	5.80	3.10	44.5	3.05	1.83	1.00	1	3
key	1	2.05	4.68	6.25	2.40	26.5	4.70	1.85	0.96	1	2
king	0	3.70	3.00	6.35	2.05	56.5	2.05	1.95	1.00	1	3
knife	1	1.95	4.82	6.45	2.15	26.5	4.30	1.56	0.96	1	3
leaf	1	2.75	3.41	6.45	2.15	32.5	3.05	1.20	1.00	1	3
lemon	1	1.30	2.95	6.20	2.60	44.5	2.60	1.15	1.00	2	5
lion	0	3.25	1.91	6.55	2.10	26.5	2.00	0.95	1.00	2	4
lorry	1	2.25	3.41	6.30	2.20	44.5	2.80	0.95	0.75	2	4
medal	0	2.10	2.15	5.80	3.45	86.5	1.60	0.78	0.95	2	4
microphone	0	1.55	2.85	6.10	3.75	102.5	2.05	0.78	1.00	3	8
monkey	1	3.20	2.09	6.45	2.30	32.5	2.10	1.00	0.86	2	5
motorbike	0	4.15	3.32	6.20	3.10	38.5	2.80	0.00	0.85	3	7
mouse	1	3.00	2.59	6.65	1.95	26.5	2.30	0.95	0.82	1	3
nail	0	1.80	2.82	5.80	2.40	68.5	2.35	1.00	0.95	1	3
onion	1	2.85	3.95	6.20	2.55	68.5	3.45	0.95	1.00	2	5
pen	1	2.45	4.64	6.35	2.00	44.5	4.45	1.30	0.96	1	3
pencil	0	2.05	4.00	6.35	2.05	38.5	4.05	1.20	1.00	2	6
pig	1	2.70	2.36	6.75	1.65	26.5	2.50	1.28	0.96	1	3
pipe	0	1.95	2.18	5.65	3.35	74.5	2.05	1.36	1.00	1	3
potato	0	2.20	3.91	6.20	2.00	74.5	3.90	1.04	0.82	3	6
queen	0	3.90	3.05	6.25	2.00	44.5	2.35	1.71	1.00	1	4
rabbit	1	2.65	2.81	6.60	1.90	20.5	2.80	1.08	0.95	2	5
ring	0	2.55	3.82	5.95	2.50	50.5	3.45	0.48	0.95	1	3

scales	1	3.10	3.20	5.60	3.40	86.5	2.60	1.00	0.87	1	5
screw	1	2.90	2.77	5.80	2.95	80.5	2.65	0.90	0.96	1	4
ship	1	3.35	3.35	6.25	2.15	56.5	2.55	1.65	0.55	1	3
shoe	1	3.20	4.68	6.40	1.30	20.5	4.25	1.18	1.00	1	2
skirt	0	3.15	3.55	6.05	2.00	56.5	3.30	1.30	0.90	1	4
snail	0	2.70	2.45	6.25	2.65	44.5	2.10	0.60	1.00	1	4
snake	1	3.55	2.05	6.70	1.95	32.5	2.30	1.18	1.00	1	4
soldier	1	4.00	3.45	6.25	2.70	44.5	2.70	1.43	1.00	2	5
spoon	1	1.90	4.64	6.30	1.45	20.5	4.05	1.08	0.91	1	4
squirrel	0	2.75	2.55	6.30	2.45	32.5	2.20	0.70	1.00	2	6
star	0	1.00	3.09	6.50	2.00	38.5	3.05	1.73	0.96	1	3
strawberry	0	2.55	2.77	6.60	2.35	44.5	2.75	0.60	1.00	3	8
sun	0	1.50	4.45	6.70	1.45	26.5	3.95	2.18	1.00	1	3
syringe	0	3.00	2.50	6.25	4.70	140	2.05	0.30	0.80	2	6
table	1	2.05	4.50	6.55	1.70	20.5	4.20	2.31	1.00	2	4
telephone	1	3.52	4.36	6.40	2.25	26.5	4.35	1.99	0.64	3	7
tent	0	2.95	3.15	6.35	3.05	44.5	3.15	1.58	1.00	1	4
tiger	0	4.35	1.77	6.60	2.45	44.5	2.20	0.70	0.80	2	4
tractor	0	3.60	2.80	6.15	2.40	26.5	2.35	0.90	1.00	2	6
train	0	3.45	3.64	6.25	2.00	32.5	3.05	1.84	0.95	1	4
tree	1	3.45	4.50	6.80	1.50	20.5	3.55	1.86	1.00	1	3
typewriter	0	3.30	3.65	5.85	3.30	86.5	2.10	1.00	1.00	3	7
umbrella	1	2.95	3.41	6.60	2.45	26.5	2.50	1.08	0.96	3	7
volcano	0	2.70	1.45	6.60	3.80	86.5	1.75	0.48	0.95	3	7
watch	1	2.95	4.27	6.30	2.25	38.5	4.10	1.58	1.00	1	4
wheel	1	3.35	2.68	6.45	2.10	32.5	2.95	1.46	0.86	1	3
wheelbarrow	0	2.40	2.80	5.85	2.75	44.5	2.00	0.30	0.95	3	7
whistle	0	2.30	2.45	5.55	2.60	50.5	2.35	0.95	1.00	2	4
window	0	3.40	4.64	6.15	2.10	32.5	3.85	2.12	0.96	2	5
witch	0	3.25	2.40	6.70	2.25	50.5	2.30	1.23	1.00	1	4

APPENDIX 8

Items and Variables for ED's Italian Picture Naming and Gender Classification

English Trans = English Translation
ED Gens = ED's Gender Score
Fam = Familiarity
R AoA = Rated Age of Acquisition
RFreq = Rated Frequency
NAgree = Name Agreement
Phons = Phoneme Length

ED Pics It = ED's Picture Naming in Italian (1 = correct, 0 = incorrect)
VComp = Visual Complexity
Image = Imageability
OAoA = Objective Age of Acquisition
WrFreq = Written Frequency
Sylls = Syllable Length

English Trans	Item	ED Pics It	ED Gens	VComp	Fam	Image	R AoA	RFreq	WrFreq	NAgree	Sylls	Phons
apple	mela	1	1	1.75	4.64	6.95	1.67	4.29	10	1.00	4	2
arrow	freccia	0	1	1.60	2.20	6.63	2.57	1.76	0	0.80	5	2
ashtray	portacenere	0	0	2.25	2.90	6.89	3.29	4.14	0	0.80	11	5
ball	palla	1	1	2.25	3.41	6.95	1.74	4.24	9	0.80	4	2
banana	banana	1	1	1.25	4.23	6.95	2.00	4.05	0	1.00	6	3
bed	letto	1	0	2.45	5.00	6.89	1.50	4.86	83	1.00	4	2
bicycle	bicicletta	1	1	3.85	4.73	7.00	1.95	4.04	9	1.00	9	4
book	libro	0	0	2.45	5.00	6.95	2.25	4.86	23	1.00	5	2
boot	stivale	1	1	2.05	4.32	6.79	2.63	3.19	1	0.75	7	3
bread	pane	0	0	1.50	4.95	6.95	1.62	4.95	35	0.90	4	2
bus	autobus	0	1	4.15	4.77	6.84	2.71	4.33	0	0.70	6	3
butterfly	farfalla	1	1	4.05	3.14	6.79	2.29	3.43	2	1.00	7	3
button	bottone	0	0	2.02	4.82	6.74	2.19	3.16	3	0.95	6	3
cake	torta	0	0	2.80	3.82	7.00	1.67	3.71	3	1.00	5	2
camel	camello	1	1	3.00	1.65	6.74	2.75	2.52	0	0.80	6	3
camera	macchina fotografica	0	0	2.70	3.35	6.79	3.63	1.95	0	0.85	17	8

candle	candela	0	0	2.25	3.55	6.89	2.25	3.19	1	1.00	7	3
cannon	cannone	1	1	3.70	1.50	6.79	2.71	2.33	1	0.95	6	3
carrot	carota	1	1	2.65	4.14	6.89	2.71	3.95	1	1.00	6	3
cat	gatto	1	1	2.60	4.18	6.95	1.43	4.19	32	1.00	4	2
chair	sedia	1	1	2.10	4.95	6.89	1.86	4.86	9	1.00	5	3
cheese	formaggio	0	0	2.00	4.45	6.79	2.10	4.57	4	0.70	8	3
church	chiesa	0	1	3.75	4.00	6.84	2.71	3.86	61	0.90	5	2
cigar	sigaro	0	0	3.58	1.85	6.95	3.57	2.81	0	0.95	6	3
cigarette	sigaretta	0	0	2.10	4.82	7.00	2.72	4.52	15	0.90	8	4
clock	orologio	0	0	2.60	4.68	6.89	2.38	4.43	11	0.85	7	4
cloud	nuvola	0	0	1.15	4.82	6.53	2.10	3.57	5	1.00	6	3
coat	cappotto	1	0	2.45	4.00	6.74	2.30	3.00	3	0.40	6	3
comb	pettine	1	0	2.00	4.73	6.89	2.22	4.33	0	1.00	6	3
cooker	cucina	0	1	3.75	4.00	6.63	2.24	3.14	0	0.80	6	3
cow	mucca	0	0	3.85	3.09	6.95	2.32	3.14	0	1.00	4	2
crown	corona	0	1	3.75	1.36	6.84	2.24	2.33	10	1.00	6	3
cup	tazza	1	1	2.05	4.60	6.95	2.47	4.52	6	0.60	4	2
dentist	dentista	0	0	4.05	2.09	6.47	2.94	2.95	2	0.95	8	3
dog	cane	1	0	2.70	4.27	6.89	1.81	4.14	47	1.00	4	2
donkey	asino	0	1	3.10	1.91	6.84	2.10	2.81	0	0.95	5	3
door	porta	0	1	2.65	5.00	6.95	2.21	4.71	21	1.00	5	2
elephant	elefante	1	0	4.12	1.41	7.00	2.48	2.52	3	1.00	8	4
envelope	busta	0	1	1.40	4.64	6.79	2.86	4.14	4	0.70	5	2
fish	pesce	1	1	2.95	3.73	6.89	2.14	4.00	12	1.00	4	2
flag	bandiera	1	1	2.00	3.27	6.89	3.06	3.10	8	1.00	8	3
flower	fiore	1	0	2.80	4.50	7.00	2.19	3.76	12	0.95	5	2
fork	forchetta	1	1	2.20	1.41	6.89	2.00	4.81	3	1.00	7	2
frog	rana	0	0	3.60	2.18	6.84	2.35	2.08	0	0.95	4	2
giraffe	giraffa	1	1	4.35	1.32	6.74	2.43	2.08	0	1.00	6	3
glass	bicchiere	1	1	1.95	4.86	6.95	1.86	4.90	10	1.00	7	3

glasses	occhiali	0	0	2.60	4.95	7.00	2.57	4.57	8	1.00	6	3
goat	capra	0	1	2.80	2.00	6.74	2.67	2.90	0	0.75	5	2
grapes	uva	1	1	3.35	3.45	6.95	2.19	3.38	15	0.95	3	2
guitar	chitarra	1	1	3.10	3.55	6.84	2.28	3.19	0	1.00	6	3
gun	pistola	1	0	2.75	1.55	6.84	2.71	2.81	5	0.90	7	3
hammer	martello	1	1	2.55	3.14	6.95	2.44	3.00	4	1.00	7	3
hat	cappello	1	1	2.15	3.68	6.89	2.44	3.38	8	1.00	6	3
helicopter	elicottero	1	0	4.20	2.27	6.84	2.63	2.48	0	0.95	9	5
hen	gallina	0	0	2.90	2.10	6.79	2.00	2.95	2	0.95	6	3
horse	cavallo	1	1	3.45	3.23	6.79	1.80	2.86	31	1.00	6	3
house	casa	1	1	2.40	4.00	6.95	2.17	4.19	0	0.95	4	2
iron	ferro da stiro	1	1	3.25	3.05	6.74	3.10	2.86	31	1.00	11	5
key	chiave	1	1	2.05	5.00	6.89	2.29	4.52	15	1.00	5	2
king	re	0	1	3.70	1.32	6.68	2.38	2.48	76	1.00	2	1
knife	coltello	1	1	1.95	5.00	6.95	2.00	4.76	6	1.00	7	3
leaf	foglia	1	1	2.75	4.27	6.95	2.06	3.24	8	0.90	6	2
lemon	limone	1	0	1.30	4.50	6.84	2.60	3.90	7	1.00	6	3
lion	leone	1	0	3.25	1.59	6.95	3.10	2.62	4	1.00	5	3
lorry	camion	1	1	2.25	4.41	6.89	2.79	3.62	6	0.95	6	3
medal	medaglia	1	1	2.10	1.60	6.47	2.72	1.86	0	0.50	6	3
microphone	microfono	1	1	1.55	2.05	6.63	3.67	2.19	0	0.50	9	4
monkey	scimmia	1	1	3.20	1.36	6.89	2.22	2.02	0	0.85	5	3
motorbike	motocicletta	1	0	4.15	4.36	6.95	2.57	3.67	8	0.85	11	5
mouse	topo	1	1	3.00	1.91	7.00	2.48	2.95	3	0.90	4	2
nail	chiodo	0	0	1.80	3.18	6.84	2.71	3.14	1	0.90	5	2
onion	cipolla	1	1	2.85	4.36	6.89	2.30	4.19	0	0.95	6	3
pen	penna	1	1	2.45	4.45	6.95	2.20	4.81	0	0.90	4	2
pencil	matita	0	1	2.05	4.45	6.95	2.29	4.38	0	0.95	6	3
pig	maiale	1	0	2.70	2.14	6.95	2.35	3.03	2	0.90	6	3
pipe	pipa	1	0	1.95	2.59	6.79	3.11	2.43	4	1.00	4	2

potato	patata	0	0	2.20	4.32	6.84	2.42	3.95	1	0.85	6	3
queen	regina	0	0	3.90	1.41	6.53	2.21	2.29	20	1.00	6	3
rabbit	coniglio	1	1	2.65	3.18	6.89	3.00	2.95	0	1.00	8	3
ring	anello	0	0	2.55	4.23	6.84	2.62	3.71	6	1.00	5	3
scales	bilancia	0	1	3.10	4.00	6.68	2.86	4.28	5	1.00	8	3
screw	vite	1	1	2.90	3.73	6.63	2.94	3.14	0	0.70	4	2
ship	nave	1	1	3.35	2.55	6.95	2.17	3.14	9	0.80	4	2
shoe	scarpa	1	0	3.20	5.00	6.89	1.62	4.52	16	1.00	6	3
skirt	gonna	1	1	3.15	4.59	6.89	2.38	3.90	3	1.00	4	1
snail	lumaca	0	1	2.70	2.95	6.84	2.43	2.08	0	0.90	6	3
snake	serpente	0	0	3.55	1.41	6.95	2.38	2.71	3	0.95	8	3
soldier	soldato	0	1	4.00	2.70	6.63	2.57	3.29	12	0.55	7	3
spoon	cucchiaio	0	0	1.90	5.00	6.95	1.71	4.57	1	1.00	7	3
squirrel	scoiattolo	0	1	2.75	2.20	6.63	2.40	3.38	0	0.40	9	4
star	stella	1	1	1.00	3.82	7.00	1.86	3.76	9	1.00	5	2
strawberry	fragola	1	1	2.55	3.18	6.79	2.38	3.38	1	1.00	7	3
sun	sole	1	0	1.50	3.95	6.95	1.63	4.19	0	0.90	4	2
syringe	siringa	1	1	3.00	1.95	6.79	3.14	2.90	0	1.00	7	3
table	tavolo	1	0	2.05	5.00	7.00	1.90	4.52	22	1.00	6	3
telephone	telefono	1	1	3.52	4.95	6.95	2.32	4.81	38	1.00	8	4
tent	tenda	0	1	2.95	3.15	6.47	3.10	1.86	0	0.75	5	2
tiger	tigre	0	0	4.35	1.45	6.84	3.75	2.48	2	0.95	5	2
tractor	trattore	0	1	3.60	2.35	6.63	3.10	2.19	0	0.80	7	3
train	treno	1	1	3.45	3.59	6.89	2.05	4.29	29	1.00	5	2
tree	albero	1	0	3.45	5.00	7.00	1.71	4.81	17	0.90	6	3
typewriter	macchina da scrivere	0	0	3.30	2.10	6.84	3.43	1.76	0	0.90	16	7
umbrella	ombrello	1	1	2.95	3.77	6.95	2.24	3.43	3	1.00	7	3
volcano	vulvano	0	1	2.70	1.75	6.42	3.00	1.90	0	0.60	7	3
watch	orologio	1	0	2.95	5.00	6.84	2.57	4.53	11	1.00	7	4
wheel	ruota	1	1	3.35	3.41	6.95	1.90	3.12	6	0.95	5	2

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wheelbarrow	carriola	1	1	2.40	2.27	6.74	2.67	2.52	0	0.90	7	4
whistle	fischio	0	1	2.30	2.35	6.47	2.95	2.19	0	0.80	6	2
window	finestra	0	1	3.40	4.91	6.79	1.76	4.19	29	0.95	8	3
witch	strega	0	0	3.25	2.30	6.47	2.38	1.29	0	0.50	6	2