Cognitive Processing of Proper Names

Jarrod Hollis

Abstract

The distinct processing characteristics of proper names have been characterised in various ways. Proper names have been considered unique, meaningless labels, and pure referencing expressions. A recent model by Valentine, Brennen and Brédart (1996) attributes the processing characteristics of people's names to processing via a token marker in memory. This thesis attempts to ascertain which of these explanations most adequately captures the processing characteristics of proper names.

The first two experiments address evidence reported by Durso and O'Sullivan (1983) that would undermine the Valentine et al. (1996) model. The experiments indicate that Durso and O'Sullivan's data occurred as an artefact of their experimental design. Chapters 4 and 5 use a repetition priming technique to explore different classes of proper names: people's names, landmark names, country names and city names. Only names of people and landmark names produced cross modal and cross domain facilitation.

The organisation of the output lexicon was addressed with five experiments reported in Chapter 6 using variants of the picture-word interference paradigm. It was found that common name distracters interfered with the production of proper name targets when a conceptual relationship existed between the target and the distracter. These data indicated that the lemma stage is highly influenced by semantic status and questioned the nature of organisation within the lemma.

This thesis provides support for Valentine et al. (1996) indicating that the processing characteristics of people's names are determined by the nature of connectivity between the lemma and the token marker. The experiments reported in this thesis extend the role of the token marker to some classes of proper name other than people's names (i.e. landmarks). The data also demonstrate that the role of a token marker is not universal for all categories of proper name (i.e. not country names or city names). Differences between categories of proper name indicate that the theoretical views of uniqueness and meaninglessness do not adequately capture the diverse processing attributes of proper names.

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Chapter 1

Introduction to Proper Name Processing

What are proper names?

A proper name is one or more words that function as a single unit of grammar.

Linguists have described the properties and characteristics of proper names in

many different ways. Nevertheless, these definitions share a number of features;

proper names designate a particular entity and are used in a different way to

common nouns. Some classes of words are most typically thought of as proper

names, such as names of people and geographical locations. Linguists have

also categorised temporal names (such as Easter, Christmas, days of the week,

etc.) titles of books and musical pieces as types of proper name. In addition,

some authors have suggested that other words, such as brand names should be

considered to be classes of proper names (Cohen & Faulkner 1986).

It is clear that the use of names in everyday language and the entities to which

they refer cover a wide diversity of use. Whilst the definition of what is a proper

name appears relatively specific for typical exemplars, such as people's names

and geographical locations, the definition for other labels remains unclear.

Valentine, Brennen and Brédart (1996) adopt the linguists' definition of proper

names as labels that pertain to unique entities. These would include: People's

names, geographical locations, landmarks and buildings, names of unique

objects and animals, names of magazines, titles of books, and names of single

events. The notion of a label being a unique referent has been adopted by a

large number of theorists who attempt to explain the dissociation between

common names and proper names. For this reason, the theme throughout this thesis considers the notion of unique reference and how this may relate to and determine, the cognitive architecture that represents proper names.

Reference and Semantics

The notion of reference refers to a word's semantic status. Theories of semantics need to separate knowledge about language from knowledge of the world; people can know what a word means without knowing what the word refers to. This difference has been captured with the distinction between what is known as sense and reference. The sense or 'intension' of a word is the concept associated with it. The reference or 'extension' of a word is the thing or things that the word applies to. The sense of dog is a concept of what it is to be a dog. There are a number of possible referents in the world that fit this concept. However, there is also a possibility that the utterance refers to a particular unique individual. Proper names are the labels that we attach to specific instances to provide a unique referent.

Theorists differ in their use of reference. Traditionally, theorists who attempt to differentiate between sense and reference were concerned with both intensional and extensional relations. Early theories were based on logic and hence the notion of truth became an important issue in theories of semantics. For Frege (1892) reference of a sentence was its truth value and sense was the conditions that the sentence must hold in order to be true. In other words Frege was concerned with intension. This notion of reference is rather non-specific; there are any number of situations in which the truth value may hold, without the

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sentence ever specifying a particular event or individual. Later theorists acknowledged that meaning is often constrained by the situational context. This led to theories such as those proposed by Barwise and Perry (1983) who suggest that reference is constrained by the context in which an expression is made.

More recent theories of semantics have focused on the everyday use of language and the contextual constraints that encompass knowledge and communication. A closer examination of the meaning of reference in the real world illustrates that knowing the specific situation or entity that an expression refers to in the world is a crucial ingredient of meaning. In this way more recent theories of semantics see reference in terms of extension, that is the specific situation or entity that is being referred to. Johnson-Laird (1983) attempts to address this with the theory known as "mental models". "Mental models" differ from earlier theories of representation as it uses reference as the crucial ingredient of semantics.

It is not clear how these approaches to meaning (and reference) can be directly related to the kind of reference that a proper name conveys. Searle (1958) and Strawson (1959) claimed that a particular selection of descriptions define an individual; the meaning of a proper name is given by a particular conjunction of descriptions that define a particular entity. However, the notion that definite descriptions specify proper names has been challenged by theorists who advocate direct reference (e.g. Kripke, 1980). According to such theory, proper names are meaningless. Although the notion of direct reference challenges other theories, these alternatives shall not be discussed further, as they do not address

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the issue of representation and so offer little to inform us about the cognitive architecture involved in the processing of proper names.

Neuropsychological Studies of Proper Name Processing

The study of neuropsychological functioning and deficits has also identified variations in the processing of proper names and common names. There are a number of case studies reporting intriguing dissociation in naming ability suggesting that not all lexical categories are equally compromised following neuropsychological damage.

Object, face and word naming are aspects of cognitive ability that are particularly sensitive to neuropsychological impairment as each stage of processing elicits the potential for damage. However, one problem for the interpretation of neuropsychological evidence is the potential for confounding. Anatomical areas do not operate in isolation and experimental tasks cannot activate isolated processes. Nevertheless, with care, a wealth of information can be sought from the study of both normal and impaired function. Evidence from a variety of sources indicates that the processing of proper names and common names may depend on different neural structures. Furthermore, evidence indicates apparent dissociation between proper names and common names may be due to differences in access (the mapping between conceptual representations and the corresponding lexical entries), or due to differences in availability and organisation within the output lexicon itself. This review will initially discuss evidence for the anatomical locus of proper name processing and then continue with a discussion of neuropsychological studies of cases where there appears to

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be a sparing of function or an impairment that is considered specific to proper names. Finally the discussion attempts to determine whether category specific deficits can be considered distinct from more general impairments.

The Anatomical Correlates of Proper Name Processing

There is evidence that the anatomical areas associated with the processing of proper names are distinct from those involved with the processing of common names. The anterior temporal lobe is often thought to be involved in the processing of proper names. This assumption has been derived from theories regarding the neuronal organisation of knowledge and naming within the left hemisphere, however evidence is inconclusive (Semenza, Mondini & Zettin, 1995). A large variety of neuropsychological information has been collected. Within the last few years, neuro-imaging (such as Positron Emission Tomography (PET), Magnetic Resonance Imaging (MRI) using techniques that were primarily designed for diagnostic investigation have received much interest. This is currently a popular method used to view the anatomical areas that are activated when the brain is required to process certain forms of the experimental stimuli. Sergent, Macdonald, and Zuck (1994) used a functional imaging paradigm to examine the neuroanatomy associated with proper names and common names. This study used the same task to directly compare faces and names. Face processing tasks such as gender categorisation, familiarity decision, and semantic categorisation activated an area between the ventro-medial and posterio-anterior cortex of the right hemisphere. On the other hand proper names activated the lateral temporal cortex of the left hemisphere. There was an

asymmetric activation for processing of information about individuals and no overlap for activation associated with the face and name processing tasks. Sergent et al. interpret this finding as an indication that information is stored in distinct regions and formats. However, when these findings were compared to earlier PET research, it was found that the rate of presentation significantly influenced the activation that was observed. Furthermore, although the right hemisphere is implicated in face recognition, it is the left hemisphere that is associated with language.

Damasio, Grabowski, Tranel, Hichwa and Damasio (1996) investigated the neural structures involved in lexical retrieval and naming for proper names and common names, comparing unique peoples names, non-unique animal names and non-unique names of tools. Their study involved the comparison of two neuro-imaging techniques with volumetric analyses. One investigation involved a large group of neurologically impaired people with focal lesions. A strong correlation was found between the category related deficit and specific neurological areas of the temporal lobe. Deficits involving impairments to people's names were related to damage in the left temporal pole. In contrast, impaired production of animal names involved lesions of the left inferotemporal (mainly anterior) area. Impairments in the processing of tool names involved the posteriolateral inferotemporal cortex and the junction of the temporo-occipito-parietal cortices. According to these data, word retrieval was associated with damage outside the classic language areas. An additional study by Damasio et al. used Positron Emission Tomography (PET) to look at the regional cerebral blood flow (rCBF) associated with producing names for the categories of people,

animals and tools.   Word retrieval of people's names produced greatest changes in rCBF in the left and right ventro-lateral temporal poles, but not in the infero-temporal areas. In contrast, animals and tools produced greatest changes in rCBF in the left posterior inferotemporal area. A small region of the left temporal pole was active for the naming of all categories of stimuli. Damasio et al. interpret this as evidence that these areas are involved in lexical retrieval. The intermediary stages of lexical retrieval involve different anatomical regions. They suggest that these regions do not contain explicit word forms, but carry knowledge of how to reconstruct a particular pattern, such as a phonological sequencing.

Other sources of evidence also suggest that a specific anatomical locus for proper name processing exists. Muller and Kutas (1996) provide evidence from a study using an electrophysiological measure (Event Related Potentials). When participants listen to sentences that commence with proper nouns (people's names) a different anatomical area is activated compared to when sentences commence with common nouns.   In summary, it would seem that a number of different sources, indicate that proper names may be processed by distinct anatomical locations to the processing of common names. Specific areas of the left temporal lobe may be implicated in proper name processing.

Another means of investigation is to study what happens when damage occurs to these specific brain regions.   A much greater range of evidence of this nature has been compiled, which may help to identify which aspects of processing are likely to be affected by impairment.

Neuropsychology of Impaired Function

Linguistic deficits due to neuropsychological impairments are known as aphasia (the term given to any impairment in the ability to understand or produce language). There are a number of various syndromes into which neurologists categorise the various forms of aphasia, categorised as a Fluent or Non Fluent form. Two of the most general labels for these syndromes are Broca's aphasia and Wernicke's aphasia; both of these deficits usually occur due to damage of the respective regions of the left hemisphere. Broca's aphasia has been characterised as a syndrome which results from damage to Broca's area - the anatomical region associated with the motor control involved specifically in language production. People with Broca's aphasia present with non-fluent agrammatic speech which is sometimes accompanied by dyspraxia and or dysarthria. In contrast, people with Wernicke's aphasia are usually fluent in their speech production, however their utterance is nonsense. They tend to omit content words, often remaining unaware of semantic errors and neologisms in their speech.

Although it may appear that a clear distinction exists between these very general forms of aphasia, there are many other subtypes of the syndrome. This is further complicated by the fact that there are no standardised systems for classification of aphasia; neurologists do not always agree with diagnostic criteria or on what basis a diagnosis should be made. Variations in the specificity of diagnosis, rely on the consultant's knowledge and expertise in recognising and categorising

language disorders. There is also a large variation among the aetiology and location of damage associated with neurological impairment. Furthermore, patients do not fall completely into one category alone. It is often difficult to isolate patient groups where deficits arise exclusively from impairment to processes associated with speech production or the semantic system alone. Diffuse damage often affects more than isolated aspects of the cognitive process and examination at post-mortem disagree over the precise neuroanatomical lesions that produce the different types of aphasia. Therefore, an understanding of the neuroanatomical correlates of cognitive processes cannot be achieved solely on the basis of neuropsychological assessment alone. Nevertheless, a large number and variety of neuropsychological cases are consistent with the view that conceptual information for person based knowledge and object based knowledge are represented, and processed using different neural areas. It follows that access to the corresponding linguistic information would be influenced and organised in a similar way.

A primary focus of interest has been category specific and modality specific impairments. These phenomena have been used to infer the nature of both semantic and linguistic representation. A number of sources indicate that there is a dissociation between what are considered common names and proper names. As deficits can arise as a result of impairment to any part of the identification or name production process, the locus of the impairment will be used to organise the remaining discussion.

Anomia

Anomia is a general term used to portray a particular class of aphasia where there is a word finding difficulty. According to simple models of word retrieval, speech production involves distinct cognitive components. The nature of the patient's impairment is dependent on the locus of the neurological damage. Consequently, the following review will be organised as follows: firstly, studies are described where impairments arise due to deficits at a semantic level of processing. These cases primarily present as impairments in comprehension of proper names. Later cases, where speech production is impaired, but semantic processing remains intact, are then discussed.

Anomia arising at the Semantic Level

There are many cases where semantic impairments have consequences for the activation of phonology and the production of speech. A large number of studies have indicated that word finding difficulties can occur due to impairments in semantic processing, such as semantic comprehension difficulties and post semantic impairments (for example, Saffran, Schwartz & Marin,1976; Wapner & Gardiner, 1979; Warrington & McCarthy, 1987; Howard & Orchard-Lisle, 1984; McNeil, Van Lancker & Klein,1990; Ellis, Kay, & Franklin, 1992; Cipolotti & Warrington,1993; Brennen,1996; Van der Linden, Brédart & Schweich,1995; Leplow, Dierks, Lehnung, Kenkel, Behrens, Frank, & Mehdorn, 1997). The precise nature of the deficit, and the category of word that has deficient processing is dependent on the location and nature of the neurological damage.

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One issue of particular importance for this thesis concerns whether there is evidence of a double dissociation in the processing of proper names and common names. Goodglass and Butters (1988) and Goodglass and Wingfield (1993) claim to have identified a patient group where there is evidence of a double dissociation between proper names (places) and common names (body parts). A spoken word-picture matching task was used to assess comprehension. They found that Wernicke's aphasics and global aphasics had better comprehension of proper names compared to common names. In contrast, anomic aphasics were found to have the reverse pattern; better comprehension for common names relative to proper names. However, Valentine et al. (1996) argues that there are a number of methodological concerns regarding this study. Firstly, only a limited range of stimuli were used for testing and matching using a visual word probe was not performed. In addition, the data suggest that the patients are reported selectively. In respect of matching performance for the verbal presentations of proper names, performance was quite poor and similar for all patients. However, performance for proper names was better if the task involved finding a location on a map. In contrast, anomic aphasics performed better in object identification than in verbal discrimination and were poor on tests that involved finding a location on a map. Valentine suggests that the design of this experiment does not allow an evaluation of the existence of a modality specific double dissociation between participants.

More generally there are other factors that reduce one's ability to accurately interpret neuropsychological case studies. Valentine et al. (1996) suggest that

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repeated testing may confound interpretations, due to the patients' repeated exposure to the experimental stimuli. It is also clear that patients suffering from degenerative disorders such as semantic dementia or dementia of Alzheimer's type are tested whilst they are in an unstable condition; performance on their tests rapidly diminishes leading to death. During this period a patient's diagnosis is often inaccurate. Evidence from patients with degenerative disorders may not be regarded as a suitable source of evidence regarding categories of knowledge. In these dementia patients processing through the semantic system is inconsistent.

A number of issues exist regarding the neuropsychological assessment of proper name comprehension. Tests of comprehension given to aphasic patients assume that word picture matching tasks demonstrate comprehension. However, word-picture matching does not necessarily involve access through the semantic system. The design and nature of neuropsychological tests requires careful consideration before large scale interpretations can be considered valid. Reports where category specific deficits occur in the absence of any semantic impairment are particularly useful in attempts to characterise the output lexicon.

Anomia without Semantic Impairment

There is evidence that forms of anomia exist that are not a result of semantic impairment. One such example is Patient EST (Kay & Ellis, 1987). EST experienced difficulty in accessing words whose meanings were available. EST's speech was fluent but often omitted object names. He was able to sort pictures into semantic categories, and accurately perform other semantic tasks such as

the "palm trees and pyramids" matching task. In picture naming his ability to produce names appeared to be related to name frequency. The names that EST had problems with were low frequency names. EST often used descriptor words to show that he recognised the items that he could not name. Hence the word finding difficulty did not arise from a semantic deficit. Kay and Ellis concluded that word finding difficulty occurred due to insufficient activation reaching the output lexicon. In the case of low frequency names, this reduced activation was not powerful enough to allow all of the necessary phonological representations to become active.

Category specific anomias without semantic impairment are also reported. However, they as not as common as those caused by an underlying semantic impairment, such as the cases discussed previously. In the realm of proper names, one such example is patient GBL documented by McKenna and Warrington (1980). Patient GBL was found to be suffering from a small lesion in the left posterior temporal region. Spontaneous speech remained intact together with normal results on tests of semantic memory, comprehension and verbal fluency. This patient was reported as having a proper name anomia that was specific to peoples names; performance on geographical locations was considered normal whereas performance on people's names was severely impaired.

Other cases with selective anomia for proper names have also been reported. Reinkemeier, Markowitsch, Rauch and Kessler (1997) describe a patient with a left medial lateral temporal lobe lesion. The patient revealed a higher than

average I.Q. with no normal memory problems. The patient was severely anomic for people's names - the impairment had persisted for 10 years and for all post-infact experiences of names. In contrast learning face-name pairs was preserved and the deficit was not associated to the ability to generate semantic or context specific knowledge for the names required.

Lucchelli and Renzi (1992) describe patient TL who presented with a selective anomia for people's names due to a left thalamic lesion. Spontaneous speech was considered normal, whereas TL appeared to have considerable difficulty in retrieving people's names, whilst naming common object pictures and naming common objects to definition achieved a near perfect performance. This was also true of naming geographical locations. Although TL was able to generate biographical details from photographs of people, his ability to name people from pictures or definitions was showed a marked impairment. This pattern of impairment has also been found for other aphasic patients such as Patient MH (Carney & Temple,1993) and a patient reported by Fery, Vincent and Brédart (1995).

Semenza and Zettin (1988, 1989) describe detailed case studies of patients with selective anomia. Semenza and Zettin (1988) describe patient PC who suffered damage to the parieto-occipital area of the left hemisphere. PC was diagnosed as a fluent aphasic; spontaneous speech was reported to be normal, but PC remained unable to retrieve proper names. One of the striking features about this patient was the perfect scores on tests of object naming. In contrast, he remained unable to name famous people and geographical locations, although

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he was able to generate semantic knowledge and perform name-picture matching for these items. This dissociation between common names and proper names extended to tests of naming to definition and category fluency. It would appear then, that P.C's deficit occurs primarily due to the process of speech production, as semantic tasks that did not require speech were performed within the normal range. Later, Semenza and Zettin (1989) describe another patient LS who suffered damage to the fronto-temporal region. LS was reported as a fluent aphasic producing spontaneous speech without difficulty but with a profound anomia for proper names. This time the deficit was reported to affect oral and written production of proper names whilst comprehension remained intact. LS was assessed using a series of tests providing data from a number of different categories using tests of confrontation naming, word-picture matching naming to description and attribute listing.

The work by Semenza and Zettin is particularly important, as the existence of a double dissociation has implications for the organisation of the output lexicon. Brédart, Brennen and Valentine (1997) argue that one needs to distinguish between impairments that involve language production and comprehension when attempting to evaluate the notion of a double dissociation between anomia for proper names and selective sparing of proper name production. Brédart, Brennen and Valentine (1997) argue that there have been no reports of patients with common name anomia and proper name preservation. They suggest that whilst a number of theories provide accounts of the single dissociation of proper names being more difficult to recall than common names, none of the studies provides conclusive evidence to suggest that proper name and common name

production are served by different routes. Evidence for a double dissociation in terms of production has not been demonstrated. Although the evidence in favour of a double dissociation for proper name comprehension is stronger, even this evidence is limited.

How specific are proper name anomias?

One problem in the comparison of different case studies is that studies all employ different forms of testing using different categories of stimuli. Many of the cases are not tested with all categories of proper name. For example, McKenna and Warrington (1978) perfromed tesing only with names of countries. In contrast, Semenza and Zettin (1988,1989) performed tests of people's names, names of countries and names of towns. However, these names were cued with map outlines, or picture postcards (presumably pictures of famous landmarks). Therefore it is difficult to determine whether the proper name anomia is truly specific to people names. The most striking variations are differences in the proper name anomia that affects people's names in isolation or together with geographic locations. Lucchelli and De Renzi (1992) suggest that this may simply reflect a severity factor. If this is the case, they predict that there should be a correlation between the severity of face naming impairment and deficits in processing other types of proper name. Hanley and Kay (1998) performed a meta-analysis on the performance of ten previously reported patients who have been reported as having impaired function in recalling the names of people, but who show a preserved ability for the recall of common names. They excluded patients who revealed impairments with comprehension, semantic knowledge, or

general word finding difficulties. Hanley and Kay (1998) organised the series of patients by their ability to name famous faces. Patients who had a general problem with proper names (i.e. who were impaired with more than just the category of people's names) were found to have the lowest scores for face naming. Their analysis therefore indicates that there is a relationship between selectivity and the severity of proper name impairment. Hanley and Kay (1998) suggest that there is no support for the notion that anomia for people's names is dissociable from other types of proper name. Differences that have been reported in the literature occur as a function of the severity of naming impairment rather than different types of naming impairments.

In summary, a variety of evidence suggests that specific areas of the temporal lobe are involved in the processing of proper names. A large number of studies indicate that semantic deficits occur frequently. In the absence of semantic problems, proper name processing appears particularly vulnerable to impairments involving speech production. Proper names of people appear particularly vulnerable. However, the neuropsychological studies need to be interpreted with caution. There has been an almost total disregard for the nature of anatomical infarct when selecting patients for study and this has resulting in a large volume of data that has produced often conflicting data. Furthermore, there has often been an inadequate assessment of naming. Evidence for names other than those belonging to people, from other categories (such as geographical locations, towns, landmarks) is limited, and testing of patients with these items has been particularly inconsistent.

Theoretical Accounts of Proper Name Processing

Theoretical accounts of proper name processing all relate to the pathways between conceptual and lexical representations. The following review will now consider some of the different attempts to characterise proper name processing. Views that the processing characteristics of proper names occur due to them being unique and meaningless labels will be addressed. The notion of proper names as pure referencing expressions, will also be considered. Finally, the recent model of proper name processing by Valentine, Brennen and Brédart (1996) will be introduced. It may be argued that there is a problem of differentiating between each theoretical position. This problem is inherited from publications which make large and unsupported generalisations from studies of people's names. However, direct quotations will be used to disambiguate each theoretical position in turn.

Theoretical claims about proper names have been based almost exclusively on the processing of people's names. In all of the recent theoretical frameworks, the specificity of links between the lexical representations of peoples' names and the conceptual representations have been emphasised. However, the nature of this specificity has been characterised in qualitatively different ways. One early attempt to characterise specificity was presented by Durso and O'Sullivan (1983) who focussed on conceptual differences. Durso and O'Sullivan presented a generic-specific hypothesis and claimed that proper names may differ from common names in terms of their semantic representations. Proper names had specific semantic features, compared to common names that had more general semantic features. Evidence in favour of this proposal was presented with series

of experiments. It is clear that differences between proper names and common names cannot be attributed to such a simple explanation and a critique of Durso and O'Sullivan's evidence can be found in Chapter 3.

Proper Names are Unique Labels

Research has suggested that proper names are just highly specific labels. One explanation based on this premise has been developed derived from Burton, Bruce and Johnston's (1990) Interactive Activation and Competition Model (IAC) that simulates the identification pathway of the Bruce and Young (1986) model of face recognition. In this model, separate modules exist of the processing of facial images and semantic information. In the IAC architecture each module is represented by pools of units that correspond to face recognition units (FRU's), person identity nodes (PIN's) and semantic information (SIU's). In models such as IAC, the PIN acts as a modality free gateway to the semantic system. Each PIN is used to specify the identity of one particular individual. Only one PIN is connected to each name whilst nodes representing semantic information receive activation from multiple PIN's. Compared to other biographical (semantic) information, people's names are difficult to retrieve because they are lexical items that have lower levels of connectivity than other types of concepts.

Other names have diffuse semantic connections and their access is mediated by the semantic system and not via a single PIN. Accordingly, Burton and Bruce (1992) presented what they termed a simple explanation based on the premise of specificity: people's names are more difficult to recall than biographical properties because names are unique. There is only one Bill Clinton, but most

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people know of many American Presidents. So, according to Burton and Bruce, specificity is directly attributed to uniqueness.

Proper Names are Meaningless Labels

A similar explanation has been provided by Cohen's Representational Model (Cohen,1990; Cohen & Burke,1993) that describes people's names as meaningless labels that lack multiple connections to semantic associates. Thus, the processing of people's names is often problematic as names in the lexicon receive insufficient activation to produce recall. Although people have many semantic attributes, their names are simply arbitrary labels with no meaning. Few semantic associations can be formed with a meaningless name. This contrasts with the representation of meaningful names, such as those belonging to everyday objects. Although object names are also arbitrary they are linked to many semantic associates. The representational model predicts a gradient of difficulty between different categories of name.

Brédart (1993) has also suggested that specificity in respect of the meaninglessness of names may be a critical factor. One study involving the production of cartoon character names, indicates that names with a meaningful component, such as Daffy Duck, are produced more accurately than those with an arbitrary name, such as Peter Pan (Brédart & Valentine, 1998). However, the use of cartoon character pictures may be problematic for a number of reasons. Firstly, it is difficult to control for recency of exposure. Secondly, the image of the character can be meaningful in different ways. For example the name Daffy Duck is meaningful as the character is physically a duck. This applies to many

characters (Bugs Bunny, Mickey Mouse etc). In such cases the image can directly cue at least part of the name. There are other cartoon characters whose names could also be considered meaningful (Road Runner, Dick Dastardly, Mutley, Hong Kong Phooey). However, in these examples, the names are meaningful in terms of the personality characteristics of the character. In the case of people's names labels do not carry meaning in either of these ways.

Uniqueness and meaningfulness are difficult to define and quantify. Indeed, both of these factors have the potential to vary at both a semantic and lexical level and depend on the sub-category of the proper name in question. For example, the country name Italy is unique (there is only one place called Italy). However, country names can be adjectivised and so there are also a host of *Italian* attributes). Country names are therefore quite different from other forms of proper name (such as the White House, the Eiffel Tower, which refer to a unique entity). Although linguistically and grammatically both landmark names and country names are considered to be proper names, landmark names offer meaning in a more direct way than country names ("The Eiffel Tower" is a tower , "Ayers Rock is a rock", "Buckingham Palace" is a palace etc.). Unlike country names, landmark names cannot be used as adjectives.

Proper Names are mediated by a Token Address in Memory

Rather than considering different categories of proper names, one might consider that all names differ in terms of the aspect of meaning that we know as reference, a specific entity that is being referred to (e.g. Johnson-Laird, 1983). The notion of

reference has been directly incorporated into alternative models of processing people's names. For example, Semenza and Zettin (1988) have suggested that people's names are difficult to recall because they are pure referencing expressions. Retrieving a person's name requires access via a token marker (an individual address in memory). Once again, people's names appear distinct from common names due to their connectivity between the semantic representation and the linguistic representations. The idea of pure reference can also be related back to models of face recognition, where a single node in the semantic network acts as a modality free gateway providing a mediation between identity specific semantics and linguistic knowledge. This point has been generally termed, the person identity node (see Valentine, Brennen & Brédart 1996; Burton & Bruce 1992) and the token marker by Burke, MacKay, Worthley and Wade (1991).

The term "pure referencing expression" may be considered to reflect names where there is reference, but no sense. The differences between what is meant by sense and reference were depicted in an earlier part of this chapter. Nevertheless it is easy to see that the name ROY CASTLE is a pure referent; the name has an identity but the word castle does not have sense in this compound. However, it is important to note that this distinction may be problematic, when one considers classes of proper name other than names of people. Consider proper names of places that are lexical compounds. The county name CASTLE MORPETH has no sense as MORPETH is a town without a castle. Furthermore, the compound WARWICK CASTLE, does provide a limited amount of sense, as the building in question is a castle.

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Recently, Valentine, Brennen and Brédart (1996) have produced a theoretical model which incorporates the notion of uniqueness and token reference. This model is important for a number of reasons. Firstly, being based on previous models of face naming, it maintains the notion of uniqueness, in terms of retrieval being difficult due to the indirect access of the linguistic information via the semantic system. Secondly, it also specifies separate routes for the processing of objects and faces. This allows an account of similarities and differences in the processing of common names and proper names. In this respect, empirical evidence and connectionist simulation provide support for Valentine at al.'s model where other models would fail to provide a comprehensive explanation (Valentine, Hollis & Moore,1998; Brédart, Valentine, Calder & Gassi, 1995, Valentine, Hollis, & Moore, 1999).

The key feature of the model is the way that the representation of conceptual knowledge is separate from lexical representation. This allows the architecture to comply with models of speech production (e.g. Levelt, 1989) The first stage of lexical access, the semantic lexicon, or lemma is common to input and output. The lemma is considered to be an abstract representation that codes both semantic and syntactic properties of the lexical entry. Note that phonological representation is provided by a separate representation termed the lexeme. Levelt (1989) suggests that lemmas are organised in terms of grammatical class, with noun lemmas falling into two main types: proper name and common name lemmas.

Proper noun lemmas specify a particular token or address in memory. In terms of models of face recognition, this is captured by a 'person identity node' (PIN). The PIN plays the role of a 'token marker' and serves as an amodal gateway to the semantic system, allowing access to identity-specific semantic information for each known person. The PIN can therefore be viewed as the point of access to the semantic system for the unique referent that it represents.

For people's names access to a person's name is only achieved via a single link from the PIN to the 'lemma' which represents their name. In contrast, access to common names from the semantic system occurs via multiple connections from units that represent the semantic features of a concept, directly to the relevant 'lemma'. Hence the connectivity between the semantic system and the lexical representations are different for proper names and common names. Figure 1 depicts the model by Valentine et al. (1996). The architecture remains largely as per the original publication. The original architecture can be found in Appendix 13. However, as this thesis portrays the processing of a number of different categories of proper name, it is considered appropriate to use the term "token marker" in place of person identity node and "type and token recognition units" in place of face recognition units/object recognition units. The insert details excitatory connections between the token marker, the semantic system and the lemma stage of processing, to illustrate how pure reference is captured by the token marker to lemma link.

The model is able to explain differences in the processing of proper names and common names. With respect to empirical investigation, one recent finding is

that people's names evince a different pattern of long term repetition priming phenomena compared to common names (Valentine, Hollis & Moore, 1998). A series of experiments indicated that people's names produced cross modal facilitation from an auditory name familiarity decision to a visual name familiarity decision. The magnitude of this cross-modal facilitation was similar to within-modality priming. Cross modality priming did not occur when common names were presented in a lexical decision task. A further experiment investigated facilitation of a name familiarity decision when a face naming task served as a prime task. Participants who had produced the names of famous people showed facilitation of a subsequent name familiarity decision task. The degree of facilitation was as great as that found when a visual name familiarity decision to people's names was repeated during the prime and test phase of the experiment. Changing the nature of the task or the modality of presentation between training and test is usually considered to reduce or eliminate facilitation (Scarborough, Gerard & Cortese,1979).

Figure 1: The Model of Proper Name Processing, adapted from Valentine, Brennen and Brédart (1996). For clarity, only excitatory links between pools of units are shown. Inhibitory links also exist within each pool of units. The insert portrays the differences in connectivity between the conceptual system and the lemma for people's names and common names.
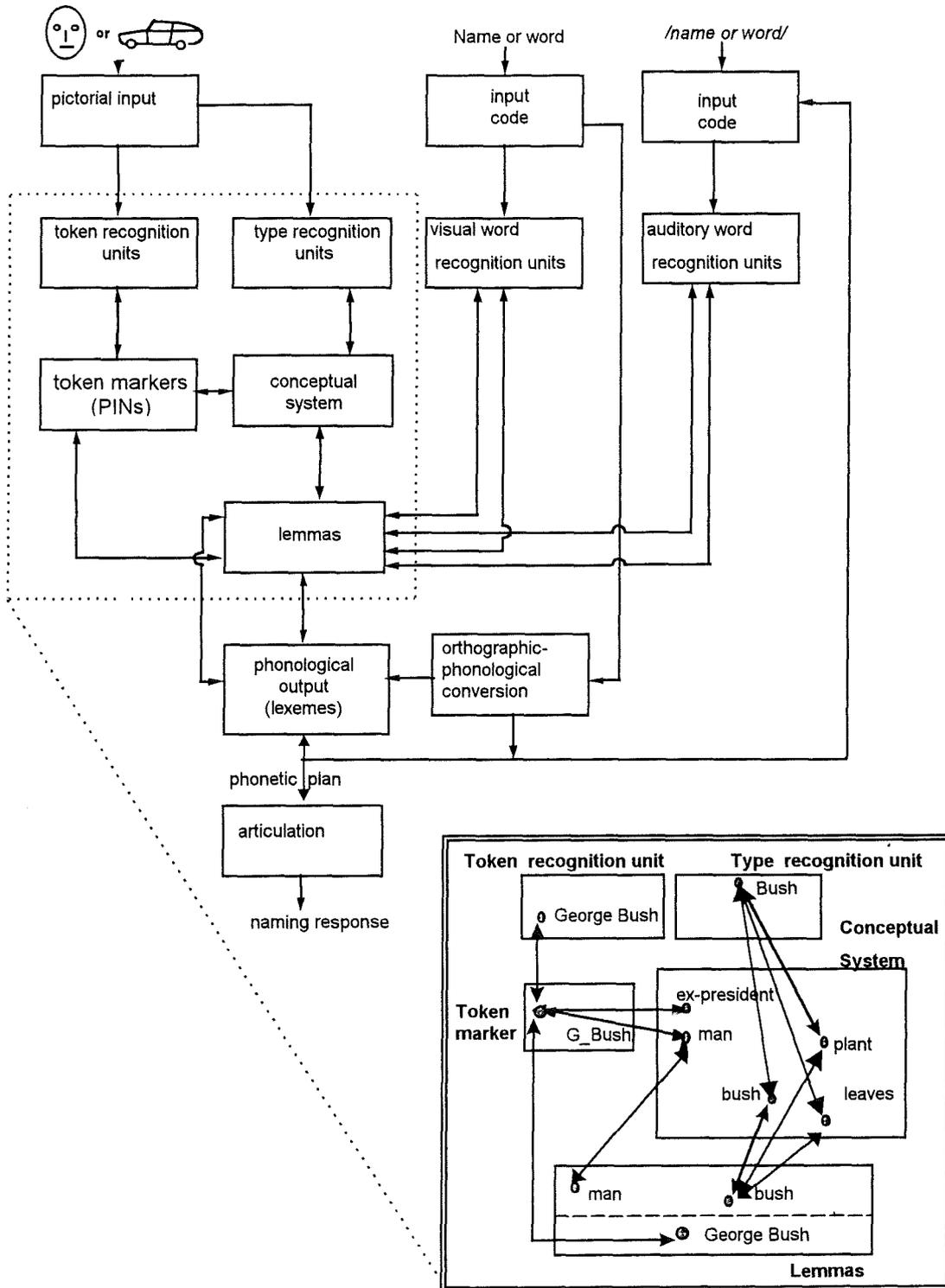
However, these findings are perfectly in keeping with the model proposed by Valentine et al. (1998). Repetition priming is considered to reflect an increase in a connection weight between different representational levels following prior processing. The weight on each link is bi-directional. Processing via the highly specific token marker-lemma linkage is required for tasks involving person identity (such as the name familiarity or face naming decision task). During the face naming task, activation must flow from the relevant token recognition unit via the token marker to the lemma. During the name familiarity decision, activation must flow from the word recognition unit via the lemma to the token marker. Both face naming and name familiarity decision tasks require access to the token marker during the prime phase and the test phase in order to successfully make the decision, and consequently the model predicts facilitation in an abstractionist (item-specific) fashion for people's names. In contrast, for common names a lexical decision is made at the level of the lemma and does not require access to token marker. The processing during the prime and test phase does not involve the same processing route and so no facilitation occurs for common names during lexical decision.

These hypotheses and the demonstration of cross-domain and cross-modality priming found by Valentine, Hollis and Moore (1998) is central to this thesis. If processing via a token address in memory is the crucial element that determines the characteristics of proper name processing then similar processing would be expected when one considers categories of proper name, other than people's names.

It is possible that repetition priming can occur due the retrieval of a prior processing episode, found in the perceptual fluency and transfer-appropriate processing accounts of priming (Jacoby & Dallas, 1981; Roediger & Blaxton, 1987). However, experiments can be designed to minimise the influence of episodic retrieval so that patterns of data cannot be accounted for in terms of an episodic explanation. These theoretical accounts of priming are detailed in Chapter 2.

Chapter 2

Research Orientation

The aim of this thesis was to test the theories of reference, meaning, and uniqueness in the domain of proper names and to determine whether the previous findings of Valentine et al. (1998) would generalise to other classes of proper name. Variations in the processing of sub-categories of proper name may indicate that differences in their representation exist. Variations in processing may also provide a basis for choosing between theories of uniqueness, meaninglessness, and token reference. To commence, Chapter 2 will introduce background material to priming and competition as methodologies that may be used to further our understanding of cognitive processing. Following the outline on methodology, the organisation of this thesis will be described together with an overview of the Experimental Chapters 3-6.

Methodology

The influence of past experience on a subsequent task can be observed as a facilitation and/or inhibition in processing of a stimulus. These changes are usually measured in terms of response time or accuracy. Facilitation is often considered a benefit of past experience, identified by faster or more accurate responses, whereas inhibition or competition is considered a cost, identified by slower, more erroneous responses. These differences in response time provide a useful way to enhance one's understanding of cognitive processing. This review will outline relevant empirical and theoretical work relating to the two

principal methodologies. Firstly, repetition priming will be considered. Repetition priming is concerned with facilitation over extended intervals. The discussion commences with an account of priming in visual word recognition. Studies involving pictorial and auditory stimuli will then be introduced. Secondly, the study of competition and inhibitory mechanisms will be considered as an alternative means to identify relationships between stimuli.

Priming

Priming is a general term applied to the phenomena of implicit or unconscious (indirect) memory. It is the influence of past experience on a subsequent task. Usually priming is portrayed as the facilitation in processing due to a previous encounter with that same item. However, the term negative priming has been also been coined to characterise occasions when prior experience results in inhibition rather than facilitation. Priming effects have been demonstrated using a variety of stimuli having a distinctive specificity and duration. As the theoretical models that will be discussed in following chapters have been based on word recognition, this review will first consider priming in the domain of visual word recognition.

Repetition Priming

Repetition priming (also known as identity priming or long lag priming) can be defined as the facilitation in processing due to a previous encounter with that same item. A prevailing methodology requires participants to perform two consecutive tasks. An initial task, often termed the prime phase or training phase, is conducted as a means of introducing the experimental (primed) stimuli. The experimental stimuli are often accompanied with a large number of filler

items so that the participant remains minimally aware of their presence. The prime phase is followed by another task, in which the experimental stimuli are experienced for a second time together with a series of matched control (unprimed) items. The facilitation to respond or identify the primed and unprimed target stimuli is determined in terms of response accuracy and/or response time; the primed target items usually elicit quicker and more accurate responses than the unprimed controls. The effect of repetition has been demonstrated using a variety of stimuli. The facilitation produced by repetition priming is usually considered to be long lived. Significant priming effects have been found for perceptual identification tasks for periods of one day (Jacoby & Dallas, 1981) and with reading tasks of up to one year (Kolers, 1976) These durations contrast to the facilitation produced from semantic priming which only lasts for a few seconds (Bruce & Valentine, 1985). Repetition priming has traditionally been considered to be domain-specific, and it has been suggested that facilitation does not readily cross stimulus domain (Ellis, Young, Flude & Hay, 1987) whereas semantic priming crosses from one domain to another (Young, Hellawell & de Haan, 1988). However, these distinctions may be too simplistic, and a discussion of the empirical evidence and theories regarding these phenomena follows later.

Initial investigations of priming phenomena were concerned with word identification, and demonstrated that word identification was facilitated by prior experience of the same word. Many studies have employed the lexical decision task as a method to study repetition priming (Scarborough, Cortese, & Scarborough ,1977). An alternative to the study of reaction times is to use a

method that requires participants to complete word-stems following a previous presentation (McClelland & Pring, 1991). Many other tasks have been utilised as a method of investigating the effect of repetition; for example, the act of speech production has been found to produce facilitation on subsequent tasks. The naming of objects is facilitated by a prior word naming or naming-to-definition task (Durso & Johnson, 1979; Lachman & Lachman, 1980; Wheeldon & Monsell, 1992; Kolers & Ostry, 1976; Kolers, 1976). Facilitation also occurs for picture naming and word naming tasks that immediately follow masked presentations of written stimuli (Ferrand, Grainger & Segui, 1994).

Non verbal material also produces various forms of facilitation on subsequent encounter. For example, naming tasks have been found to prime familiarity decisions to faces and names (Bruce, 1986; Bruce & Valentine, 1985; Valentine, Hollis & Moore, 1998). Naming tasks have also been used to prime object stimuli; for example, in familiarity decisions to line drawings of real or unreal (novel) objects (Kroll & Potter 1984) and for identification of object pictures from brief presentation (Warren & Morton, 1982).

Facilitation has also been found when stimuli are presented in the auditory modality. Auditory stimuli range from spoken words (Gipson, 1986; Jackson & Morton, 1984) to human voices (Schweinberger *et al.,* 1997; Ellis *et al.,* 1997). Although an abundance of evidence demonstrates repetition priming, debate continues about the nature and loci of the facilitation. Early theories claimed that central to this issue was the distinction between general and specific knowledge. A number of different theories have attempted to account for the phenomena of

long term repetition priming. They can largely be categorised as abstractionist (item specific) or episodic accounts (Tenpenny, 1995).

Episodic Accounts of Repetition Priming

Episodic accounts of repetition priming are related to memory phenomena. According to these perspectives facilitation of the performance of any task is a direct result of retrieving the previous processing episode from memory. This memory trace includes information about the perceptual experience, the task itself (such as the response decision or the cognitive strategy used to perform the task) and the response required. Performance on a subsequent encounter with the same task is advantaged, as the memory trace provides a cue to the response required (Hintzman, 1986; Jacoby, 1983; Jacoby & Brooks, 1984). Similarly, Tenpenny (1995) describes the similarity between two presentations as "overlap" suggesting that this is the main determinant of facilitation. Where repetition occurs in the absence of interference from other items, recognition is enhanced. Facilitation is thought to occur due to the use of specific episodes; newly acquired episodes are more accessible than older ones. Specific memories of previous encounters are used to perform the most recent task.

Two distinct forms of episodic explanation have been formulated. The first, known as *transfer appropriate processing*, claims that the experience of performing a particular task (i.e. including the response) benefits a subsequent encounter. Another episodic account known as *perceptual fluency* is more concerned with the characteristics of the experimental stimulus itself. Both of these accounts maintain that facilitation occurs as a function of previous experience. The nature of the episode is distinct for each account.

Perceptual Fluency

Perceptual fluency is concerned with episodes of the stimulus characteristics. Jacoby (1983) forms a distinction between data driven and conceptually driven processing. These two types of processing differ in terms of the information that is required to perform the task. This distinction has been used to explain the dissociation between direct and indirect tests of memory. Hence, the episodic account of repetition priming does not differ from explicit memory phenomena. Data driven processing only requires information about the physical features of a stimulus whereas conceptually driven tasks require semantic processing. This allows some tasks to benefit from previous experience of the physical features of a stimulus alone. One example of perceptual fluency is provided by Roediger and Blaxton (1987) who found less priming of typed words in a fragment completion task if the experimental stimuli had previously been presented in handwritten form rather than typed. In other words, a proportion of the facilitation occurred due to the physical characteristics of the visual stimulus.

Transfer Appropriate Processing

A slightly different perspective is taken by the transfer appropriate processing account. Here it is the episode of performing the task that benefits a subsequent repetition, particularly in terms of the processing required in performing the experimental task following a stimulus presentation. As both the perceptual fluency and the transfer appropriate processing perspectives assume that the benefit of repetition is due to episodic intervention, the degree with which the stimuli or task remain constant between the two presentations should reflect the

amount of facilitation that is observed. Accordingly, these perspectives predict that facilitation should be strongest when the stimuli and the task remain exactly the same, whereas large changes to the stimuli, task and response, should reduce or eliminate facilitation (Blaxton, 1989; Roediger & Blaxton, 1987; Roediger, Weldon & Challis, 1989). Schneider and Shiffrin (1977) claim that stimulus-response/decision mappings significantly add to facilitation when responding to stimuli that are presented over many repetitions, but this is less likely to affect facilitation after a single trial. Logan (1990) found swapping response keys left/right hand between prime and test had no effect on priming during lexical decision. Information regarding the response was not utilised in the priming phenomena. Ellis *et al.* (1990) found that making a gender decision to faces at prime facilitated subsequent experience when a familiarity decision was given at test. However, when a gender decision at prime was followed by an expression decision at test no priming was found. These studies indicate that changes to the stimulus form, or the experimental task do not always reduce or eliminate priming; the nature of the decision, and the type of stimulus is also an important consideration.

Tenpenny (1995) claims that the episodic account is suited to the explanation of repetition priming over extended periods. However, there are cases which indicate that purely episodic accounts are no more viable that those Tenpenny (1995) would like to reject. Cross-domain and cross-modal repetition priming make a purely episodic account untenable as "overlap" of the stimulus is limited. These experiments use different forms of the same stimuli. As a result, facilitation that is produced is unlikely to be due to the retrieval of specific stimuli.

An alternative to the episodic account of priming is that of the abstractionist approach. This perspective is particularly useful at explaining priming on occasions where the episodic account would not provide a tenable solution. Studies which are particularly relevant to this thesis will be discussed at the start of each experimental chapter. The abstractionist approach has been validated by Dean (1995) and Dean and Young (1996) who contrast the abstractionist and episodic explanations of long term priming. In their experimental presentations pairs of picture-word stimuli were presented for semantic (same/different) decision. The stimuli pairs were re-combined in a variety of ways, so that both episodic and item-specific (abstractionist) effects could be identified. Data supported an abstractionist account of repetition priming only. The abstractionist account will now be detailed.

Abstractionist Accounts of Repetition Priming

The abstractionist (or item specific) account of repetition priming is an alternative to episodic theories. Pure abstractionist accounts suggest that there are distinct differences between episodic representations and the representation of item specific entries, such as lexical items. These accounts explain repetition priming in terms of perceptual experience activating a specific representation, as processing progresses through the recognition and identification process. The weak abstraction perspective maintains that recognition occurs mainly through the activation of lexical representations but acknowledges that specific episodes have the potential to take part in the recognition process under appropriate conditions. The abstractionist perspective draws heavily on the literature of word

recognition, in particular Morton's (1969, 1979) logogen model of word recognition, for this reason this perspective will be detailed in these terms. However, models of object and face recognition (such as those by Bruce & Young 1983; Burton & Bruce, 1983; Humphreys, 1988; Valentine, Brennen & Brédart, 1996) have been based on the logogen model and so the abstractionist perspectives can be easily applied to models that involve non-verbal processing. According to Morton's (1969,1979) Logogen Model of word recognition, experiencing a visual presentation of a word results in the activation of a specific entry in the lexicon, or word recognition unit, otherwise known as a logogen. These may be considered to be like recognition units for specific instances that are required for identification purposes. Each type of sensory information that has been experienced has an individual representation. Dean (1995) describes logogens as abstract representations of identity, that describe generic features from past experience. When a particular item (such as a word) is experienced, logogens that have a close correspondence to the sensory input fire; the specific logogen for the exact perceptual representation exceeds a threshold of activation. Once this initial recognition has occurred, identification and further processing such as the retrieval of semantic information can be accessed. The firing of a logogen is relatively long lasting with the activation decaying slowly. If a subsequent presentation of the same sensory experience occurs before the recognition unit has returned to its resting level repetition priming occurs. This facilitation is observed as activation lowers the logogen threshold. Therefore recognition appears facilitated on a subsequent encounter. The most recent version of the logogen model suggests that there are modality specific subsystems associated with the visual and auditory systems. Each logogen

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codes generic information, as a summation of all experiences with each particular exemplar. Any encounter with a word is mediated by the same logogen. Furthermore, the logogens may represent the root morpheme of a word rather than the whole words themselves. Murrell and Morton (1974) found that identification of a word was facilitated by a prior exposure to a morphological related word but not a visually or acoustically similar word. According to the abstractionist account, the locus of priming occurs in the representations that are specific to the task in question and not as a function of episodic memory or the processing operations.

Models of object and face recognition have been based on the logogen model. These models claim that abstract representations of object or face identity mediate the recognition process. Repetition priming in these models has been accounted for in the same way as that of word stimuli. However, one problem for the abstractionist approach is that non-words and novel (unreal) objects have also been found to produce repetition priming. (Feustel, Shiffrin & Salasoo, 1983; Kroll & Potter, 1984). To explain this kind of priming in terms of the abstractionist paradigm sub-lexical or sub-object representations are necessary; just as a word fragment can be priming, so component features or parts of objects would be primed. This is not an unlikely proposal. Dorfman (1994) reported priming for non words but only when the words were constructed from a familiar structure. Similarly, a study by Schacter (1990) found priming only for structurally possible but not impossible images. This is in keeping with the notion that the novel stimuli are represented in terms of pre-existing sub-components. Novel stimuli may then be regarded as novel combinations. A new representation may be

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formed after a single encounter, or alternatively, facilitation could be due to the activation of sub-components. There is some difference of opinion as to the exact nature of priming in an abstractionist perspective. Morton's (1969) model asserts that firing of a logogen results in identification, which is accompanied by a change in threshold level. However, each logogen requires a separate threshold which leaves many free parameters to account for. Alternatively, McClelland and Rumelhart (1981) suggested facilitation occurs due to an increase in resting level rather than a change in threshold level. Monsell (1991) asserts that repetition priming occurs due to changes in weights (connections) between units rather than within the units themselves. This position is particularly desirable as it can be applied to parallel distributed processing where weights of connections are changed and determined by the network's prior experience. This is also in keeping with many computer models such as the interactive activation model proposed by Burton, Bruce and Johnston (1990) and Brédart, Valentine *et al.* (1995).

Changes in Modality and Domain

The abstractionist paradigm is desirable as an account for priming phenomena as it can explain data that remain difficult to explain with a purely episodic account. For example, when priming occurs following changes to the form or context of the experimental stimuli. In such cases, the episodic accounts of priming are less viable. Traditionally it has been suggested that changing the format in which a particular stimulus is presented reduces the facilitation produced by repetition the item. Maximal priming is expected when the stimulus and the task remain constant in both the prime and the test phase of the

experimental presentation. Less facilitation (but significant priming) has been found for visually presented words in a variety of tasks such as word fragment, stem completion, lexical decision, degraded word identification, and if the prime phase has been conducted in the auditory modality (Graf, Shimmura & Squire, 1985; Hashtroudi, Ferguson, Rappold & Chronsniak, 1988; Roediger & Blaxton, 1987; Scarborough et al., 1979). However, there is some disagreement about the degree with which facilitation can transfer from one modality or domain to another. A number of studies have found little or no benefit to subsequent processing if the modality or domain is changed between prime and test. For example, Jacoby and Dallas (1981) report no significant cross modal priming from an identification task for brief presentations following an auditory prime compared to a visual prime.

A number of other studies have also failed to find cross modal priming in word recognition, (Morton, 1979) and in word identification in noise (Ellis, 1983; Clarke & Morton, 1983; Jacoby & Dallas, 1981). A total absence of cross-domain and cross modal facilitation is supportive of the episodic account of priming. However, other studies show that facilitation can transfer between stimulus modality, and domain. In contrast to a control condition in which maximal priming is expected, most studies indicate the magnitude of this priming is reduced following changes in modality or task (Jackson & Morton, 1984; Bassili, Smith, & MacLeod, 1989; Weldon, 1991; Kirsner & Smith, 1974; Kirsner, Milech & Standen, 1983; Hunt & Toth, 1990; Weldon, 1991).

Changes in prime domain have also been studied. In these manipulations, the item is presented in contrasting forms, such as a verbal (written) name followed by a picture of the same item. In general, changes in domain produce priming phenomena similar to those found with changes to modality. Long term facilitation is usually reduced or eliminated (Winnick & Daniel, 1970; Scarborough et al. ,1979; Durso & Johnson,1979; Warren & Morton, 1982; Weldon & Roediger, 1987; Bruce & Valentine,1985). The presence of cross-domain facilitation can be explained with both the episodic and abstractionist perspectives. According to the episodic account, the closer the processing demands at prime and test the greater the benefit of previous encounter. Changes in domain or modality result in changes to the operations required to perform the task at test. Thus, changes are thought to reduce or eliminate facilitatory effects. However, whilst priming has been shown to remain in some tasks such as word fragment completion (Hirshman, Snodgrass, Mindes & Feenan, 1990) it is eliminated in others such as perceptual identification (Jacoby & Dallas, 1981). Episodic accounts explain these differences in terms of the data-driven/conceptually driven hypothesis: changes in modality or domain affect perceptual or data driven tasks but do not alter conceptually driven tasks. Roediger *et al.* (1989) claim that priming is more affected by conceptually driven tasks such as word-fragment completion compared to perceptual identification tasks. In other words, it is semantic (conceptual) processing that is contributing to the priming phenomena.

Abstractionist accounts explain the reduction in cross-modal and cross-domain priming due to different representations being activated for the recognition of

auditory and visual information. If the task can be performed with a structural analysis alone, performance at test can only benefit from prior experience if the same recognition unit (i.e. within the same domain/modality) is used in the second task. However, is also evident that some tasks require more than structural analysis, and it is this kind of task that may show facilitation that crosses modality or domain. Cross modal or domain priming at a significant level can also be explained with the abstractionist paradigm by suggesting that if the task activates a modality independent connection, facilitation is observed to cross modality. For example, Bruce and Valentine (1985) and also Wheeldon and Monsell (1992) found that speech production tasks facilitate the naming of stimuli on subsequent tasks. Bruce and Valentine (1985) found that cross modal effects are reduced in tasks that only require identification compared to tasks that require speech production.

Evidence suggests that it is the connections between conceptual representations and the semantic lexicon rather than activation at the semantic lexicon alone that are important. A series of experiments were conducted by Valentine and colleagues, who used words such as Bush that could be classified as both a common name and also a surname of a famous person. Valentine, Moore, Flude, Young and Ellis (1993) found that a familiarity decision to a familiar full name, produced a repetition effect on a subsequent lexical decision to words that had been previously seen as surnames. The converse was also found. These findings were interpreted as support that facilitation occurred due to the repeated activation of representations accessed by both common names and proper names. A later study involved similar stimuli, but required participants to overtly

produce the names during the test rather than make a familiarity decision. Valentine, Moore and Brédart (1995) presented participants with a series of words (such as Major) and asked to produce the names. This activity did not facilitate a later task of producing the same name when participants were instructed that these items were celebrity surnames (e.g. Major as in John Major). This finding was interpreted as evidence that the semantic lexicon was organised into different areas, depending upon the classification of the words themselves. The results of these studies suggest that leading up to lexicalisation, proper names and common names prime one another. This assumes that links are automatically activated for all entries of a word when it can be processed in both a common name and proper name form. This would also imply that conceptual representations for common names are also activated when a proper name is encountered. This is consistent with work that has been carried out with homophones, where both meanings of a homophone are available for a limited period. Wheeldon and Monsell (1992) found that producing a homophone did not prime picture naming at test. They suggested that the locus of priming cannot be at the phonological level of processing, but occurs between the representation of meaning and spoken word form. In tasks that require naming the locus of priming may be in the production system rather than those involved in identification Durso and Johnson (1979) found that when object names were read out loud, a subsequent picture naming task was facilitated. However, more facilitation occurred when the same task was repeated. In other words changing the task may reduce the number of loci for the facilitation to occur. The results of these experiments indicate that the locus of priming that occurs for tasks involving speech production is quite specific. Valentine and Bruce (1985)

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found that reading a name facilitated a subsequent face naming task, whereas reading a name did not facilitate a face familiarity decision. These data show that the locus of priming is at a relatively late stage in processing, that requires naming during the test phase. Similar findings have been reported by Ellis and Young (1987). Other evidence has shown that facilitation is unlikely to be due to semantic influences alone. For the naming and reading of common names a direct, non-semantic route has been identified by different authors (Morton & Patterson, 1980; Ellis & Young, 1988) However, this route is not apparent in early models of object or face naming (e.g. Bruce & Young, 1986). Therefore, as naming a visually presented name does not facilitate a face classification task it would appear that facilitation such as that reported by Valentine *et al.* occurs due to a stage in lexicalisation rather than semantic influence alone.

Summary of Repetition Priming

The effect of repetition over extended periods has been demonstrated using a wide variety of stimuli. Repetition priming has been shown to have distinctive domain specificity and duration. Two accounts of repetition priming have been presented, the episodic account based primarily on literature from explicit memory phenomena and the abstractionist account based on models of word recognition, such as the logogen model. Both accounts provide alternative explanations for priming phenomena. Although both perspectives have utility, designs that involve cross-modal and cross-domain presentations or changes to the experimental task and stimuli are most adequately captured by the abstractionist perspective. The literature regarding these changes is varied. However it would appear that repeating the same task or presenting the experimental stimulus in the same form during both phases of the experiment

produces greater facilitation than when the task or stimulus form is altered between the prime phase and the test phase. The episodic account reveals that episodic intervention may occur should task demands make it necessary. This perspective yields many indications for experimental design. Tasks that require high processing demands without constraints on the participants' response time (such as stem completion and fragment completion or designs where the test phase is conducted as a tachistoscopic presentation or word identification in background noise) are the tasks that are most likely to be influenced by episodes. Ideally these tasks are avoided in an abstractionist methodology. Accuracy alone may not be an appropriate indicator and a measure of reaction time is desirable. Tasks such as speeded familiarity decision, and masked priming in which the participants remain unaware of the prime cannot readily be explained in terms of an episodic account. These tasks can be designed to be conceptually driven and do not involve the participants having to deeply encode or make great efforts to analyse the stimuli (compared to tasks such as word identification in noise). They can also be designed to minimise episodic intervention by incorporating design features such as the inclusion of a high proportion of filler items compared to the numbers of experimental stimuli. Finally, priming may not always be a pure process and the recall of episodes may contribute to facilitation to a greater or lesser degree.

Interference, Inhibition and Competition

An alternative way to explore the connectivity is to observe interference between two different representations. Interference is related to spreading activation. In particular, it indicates how the activation in one representation may compete with or inhibit the processing of other representations that share semantic

connections. Interference, a reduction in accuracy or responses time to process stimuli is a consequence of competition or inhibition and once again these processing differences can provide a useful means of assessing the strength of connectivity between two item specific representations. The term inhibition has been used in a variety of ways. Generally, it refers to an increase in response time compared to a baseline. Theoretically this can be explained in a number of different ways. Increases in response time can be attributed to competition between a number of representations (e.g. Glaser & Glaser, 1989). For the purposes of this thesis, and in line with IAC style architectures, I will use the term inhibition to indicate this type of mechanism. However, it is important to distinguish a different account which can be found in studies of picture naming and speech production. Here, inhibition is considered to arise when the activation of a stimulus falls below its usual baseline. For example, Wheeldon and Monsell (1994) have shown that picture naming is slower when a competing word had been recently produced to a definition. This inhibitory effect occurred when there was a lag of two picture items between the definition and the target picture. However, when the definition was given immediately prior to the picture or in excess of several minutes the effect disappeared. Wheeldon *et al.* concluded that an increase in the availability of a competing candidate appears to retard word selection during lexicalisation. Other studies have also provided this explanation of inhibitory mechanisms. Vitkovitch, Kirby and Tyrell (1996) have shown that when participants name a series of animal pictures, errors match names that had been produced several trials earlier, but never match the name which was produced in the immediately preceding trial. These findings indicated that access to a representation was subject to a brief inhibitory period. When

participants are required to name a series of pictures, and responses have to be made within a 600ms deadline, more naming errors occur when the series of pictures are structurally similar (Vitkovitch, Humphreys & Lloyd-Jones 1993). Response times are also slower when a series of semantically related pictures are presented for naming (Humphreys, Riddoch & Quinlan 1988).

Picture-word Interference

Picture-word interference is well established as a methodology. It involves the simultaneous presentation of a picture and a word for tasks such as categorisation and naming. The methodology differs from interference in the speeded picture naming experiments, as interference is measured between the picture-word pairs that are presented within the same trial, rather than over longer periods. Although many studies have contrasted data from categorisation tasks with that of name production, the following discussion will focus on research that requires the participant to make an overt naming response, as the process that is of particular interest is the mapping from the conceptual (semantic) system onto the lexical representations. In the picture-word interference paradigm the participant is presented with a target picture and a distracter name and told to respond (name) only to the picture. When the picture and word are from the same semantic category, picture naming is slower than when the picture and word are not related (Underwood,1976; Lupker,1979; La Heij & Vermeij,1987, Lupker & Katz, 1981; Rosinski,1977; Golinkoff & Rosinski, 1976; Roelofs, 1992). The interference effect seems to depend on two principal factors. Firstly the nature of the semantic relation between the distracter word and the target picture, and the timing of the presentation. The basic premise is

that semantic-related distracters produce more interference than unrelated distracters (Underwood, 1976; Rosinski, 1977) However, if the distracter words share an *association* with the target picture, rather than a categorical relation, interference is reduced or eliminated (Lupker, 1979; La Heij et al. ,1990). Glaser and Dungelhoff (1984) manipulated the presentation of the distracter and target, in terms of the time between the onset of the distracter word and the onset of the target picture (Stimulus Onset Asynchrony-SOA). Greatest interference was found when the distracter and the target picture were presented simultaneously. There was a smaller effect when the distracter appeared 100 ms before picture, whilst no interference was found when word preceded target by 200 ms or more. As the SOA increased, facilitation rather than interference is often produced. La Heij, Dirkx, and Kramer (1990) found that highly associated pairings produced facilitation when the distracter was presented 400 ms before the picture target. No facilitation was found for highly associated pairs with a simultaneous presentation of the distracter and target. For weaker associates categorical interference occurred from simultaneous presentation for up to 150 ms after the picture. They argued for two separate effects: facilitation from associated items and interference from categorically related items. The time course of the picture-word presentation determine which effect is dominant and observed. Facilitation occurs for strong associates and for weak associates when pictures follow words. Interference occurs when there is a an overlap in access to the name codes for the distracter and target, however strong associations cancel out interference. Briefly, other factors such as the orthographic and phonological properties of words, have also been found to influence the interference effects (Briggs & Underwood, 1982; Posnasky & Rayner, 1977; Rayner & Posnasky,

1978). For example, simultaneous presentation of non-words that share orthographic features with the target facilitate naming, whereas if the SOA is reduced to 35 ms interference was found. A similar finding was produced when phonological similarity was manipulated.

The locus of interference

As I have discussed previously, the locus of interference has been interpreted in terms of competition between related representations. In other words, the tendency to name the distracter must be suppressed (Dyer,1972; Posner & Synder,1975). Seymour (1979) claims that the locus is at the semantic stage of processing. Smith and Magee (1980) performed a series of studies with picture and word stimuli. Picture naming was hampered by the presence of a semantically related word. This contrasted with word categorisation which was hindered by the presence of a semantically related picture. Smith and Magee argued that these differences reflected the speed of response generation. Word naming is faster than picture naming, and so words interfere with picture naming. In contrast, picture categorisation is faster than word categorisation so pictures interfere with words when the task is changed to categorisation.

Two alternative accounts provide further conflicting ideas regarding the locus of the interference effect. Rayner and Springer (1986) argue that semantic evaluation causes the bulk of interference, whereas La Heij (1988) and La Heij *et al.* (1990) assert interference occurs at the level of name retrieval. A problem for the semantic decision account is why pictures interfere with word categorisation. Placing the locus of interference at the stage of name retrieval hypothesis

allows an explanation of how orthographic similarity facilitates name retrieval. It can also account for the asymmetry for interference on picture naming and word categorisation. The locus of interference during picture naming can be placed at the level of name retrieval, whereas effects on word categorisation can be placed at the semantic level. As pictures have privileged access to semantic information they can generate semantic interference on word categorisation. Words may have privileged access to lexical representations and so interfere with semantically mediated tasks such as picture naming. This account can also explain why Stroop like interference is eliminated when the task does not require name production (Flowers & Dutch, 1976).

Recent research provides continued support that the locus of interference occurs at the level of name retrieval. Shriefers , Meyer and Levelt (experiment 2, 1990) used a picture-word interference paradigm to investigate name production. This study provided a detailed analysis of name retrieval by assuming that lexical access involves two distinct stages. First the lemma stage provides access to an abstract code that is predominantly influenced by semantic and syntactic properties. This is followed by the lexeme stage when phonological information is retrieved. Shriefers *et al.* used a picture-word paradigm with the distracter words (related, neutral and unrelated) presented in the auditory modality. An initial experiment (Shriefers *et al.*, experiment 1) was used to determine what kind of item should be used to provide an appropriate "neutral". They compared silence, white noise and the non word "blank". Results indicated that white noise did not produce any difference in responses compared to silence. In contrast the word "blank" produced interference but this was significantly less than that found

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in the unrelated presentations. They concluded that the word "blank" would act as the most appropriate neutral stimulus.

In line with previous studies, a second experiment established that picture-word interference was dependent on the time course of the presentation. With an SOA of -150 ms (distracter word commenced presentation 150 ms before picture) words that had a semantic relationship with the target picture interfered with naming. In contrast, distracter words that were phonologically related to the target picture were found to produce facilitation when the SOA was extended to +150 ms. They concluded that there was a stage of lexical access (the lemma) where only meaning was activated, following by a stage that was influenced by phonology. These results supported the two-stage lexical access accounts of speech production. They also indicate further support for the locus of interference in the picture-name paradigm being at the level of the name retrieval.

One important difference between the study by Shriefers *et al.* and the other studies that have been described, is that Shriefers *et al.* presented the distracter word in the auditory modality. One might argue that auditory presentation is problematic due to timing. However, visual presentations of picture-word pairs are also subject to criticism; words have to superimposed over the picture, or the placement of the words needs to be carefully randomised. Participants may try to use strategies such as a shift in visual attention in order to try to avoid reading the words. Although potential problems exist for each type of presentation, there appears to be a consensus in empirical findings. Semantic relationships effect processing.

The picture word interference paradigm has also been extended to the study face recognition. Young, Ellis, Flude, McWeeny and Hay (1986) performed a series of experiments based on the picture-word paradigm using people's faces with related and unrelated people's names. Printed names interfered with naming photographs of a related face. For a name categorisation task, faces interfered with printed names. These findings are comparable to picture-word studies with objects. No interference was found from categorical relations between faces and names but associative relationships between faces and names produced significant interference.

More recently, Humphreys, Lloyd-Jones and Fias (1995) have developed a variation of the picture-word paradigm, that has been termed post-cued picture naming. In this paradigm, participants see two object pictures and later they are provided with a cue to name only one of them. Naming is slower when the two stimuli are semantically related. The effect is robust for picture-picture pairs and is also found for pairings that are both pictorial and verbal (i.e. picture-word pairs), as this induces semantic processing. The interference effect is eliminated when the pairing occurs with two words alone, and also when the experimental task involves categorisation rather than name production. These results were analogous to the those found in the classic picture word interference paradigm, and the locus of interference is attributed to the process of mapping semantic information onto names.

Summary of the Picture-word Interference Paradigm

The picture word interference paradigm has been used to study the processes involved in object and face naming. Studies identify a number of possible loci for the interference effect, the most likely explanation being that interference occurs at the stage of name retrieval. Humphreys *et al.* (1995) provide a succinct summary of empirical research involving various interference type experiments. Humphreys *et al.* (1995) assert that interference effects are likely to be influenced by several factors: the nature of the relationship between target and distracter, the format of target and distracter, and the timing of the stimulus presentation (SOA).

General Summary of Methodology

The discussion has shown how studies involving priming and interference have been used to elucidate our understanding of word and object and face recognition. All of these accounts assume the basic premise that there is an automatic spread of activation between item specific representations. Priming is usually considered a benefit of this activation passing from one representation to another, being seen as facilitated processing. Although this "abstractionist" account is preferred, the role of episodic strategies in the form of expectancy is acknowledged. Indications to help eliminate or control for these effects were discussed. An alternative method of investigation is to view interference, a cost of activating item specific representations. Competition between two related stimuli can be observed as inhibited processing.

Unresolved Issues

A number of issues remain unresolved. Firstly, what underlies the differences between the categories of proper name? Why are geographical locations easier to name than people? Are geographical locations easier to name because they can be adjectivized (Hittman-Delazer et al.,1994)? Alternatively can these differences be simply related to uniqueness or meaninglessness? If the ability to use nouns in different forms (e.g. country names which can be used as a noun and adjective) is central to differences in the sub-categories of proper names, one would expect differences between items whose name cannot be adjectivised, compared to items whose name can be readily produced as an adjective. If these findings are not artefacts of the neuropsychological condition or testing, one would expect differences in the processing attributes for both impaired and in normal function.

Secondly, can we attribute the differences between common names and proper names to the respective mappings between conceptual knowledge and the output lexicon? The issue concerns whether the collection of knowledge that describes an entity is linked directly to its label in the semantic lexicon or whether processing is mediated by another module before the retrieval of a name. This is particularly valid for the study of proper names as the idea that proper names may be attached to semantic knowledge in a different way to common names has been suggested by a number of researchers.

Organisation of this Thesis

This thesis begins with two experiments that test the utility of the model of proper name processing proposed by Valentine, Brennen and Brédart (1996). Durso and O'Sullivan (1983, Experiment 1) reported that the time taken to read proper names aloud was reduced by prior experience of naming the same item's picture. In contrast no facilitation in reading common names was found. These data are inconsistent with a framework of face, word and object processing proposed by Valentine, Brennen and Brédart (1996).

Two replications of Durso and O'Sullivan's experiment are reported, which incorporate additional control of the attributes of proper names. In the first experiment, participants were required to name pictures of famous people, famous landmarks and everyday objects. In a subsequent task they read aloud a series of words which included the names of some items encountered in the previous task. A second experiment was conducted with landmark names only. The results show that for the word naming task, no proper name specific facilitation occurs. The data in Chapter 3 are therefore consistent with the Valentine *et al.* (1996) model.

Once the utility of the model by Valentine et al. (1996) has been addressed, the remaining experimental chapters consider different categories of proper names. Chapters 4 and 5 report a series of experiments using a repetition priming technique to explore the cognitive phenomena associated with proper names. Chapter 4 deals exclusively with cross modal repetition priming. It was found that

for people's names and landmark names making a familiarity decision to an auditory presentation of a name primed a familiarity decision to the same item's written name. No comparable facilitation was found for country names or city names. Further experimentation indicated that the lack of cross modal facilitation found with the country names and city names was unlikely to relate with conceptual specificity, or to name frequency or familiarity.

Chapter 5 reports two experiments concerned with prime tasks that require name production. It was found that for pictures of people and landmarks, production of a name in response to seeing a picture primed a subsequent familiarity decision to the same item's written name. No such priming was found when country names were produced to map outlines (Experiment 5.1) or pictures of landmarks (Experiment 5.2).

Chapter 6 presents experiments that address the organisation of the semantic lexicon using an interference paradigm. Using a post-cued naming procedure, common name distracters were found to interfere with the naming of people's faces, when a categorical relation existed between the common name distracter and the proper name target. These findings were replicated with a more conventional picture word interference methodology. The results indicate that connectivity at the lemma stage is highly influenced by semantics rather than syntactic class.

General discussion of all of the experimental studies is presented in Chapter 7. Implications for the generality of proper name processing are considered together. Theoretical views that proper names are unique, meaningless labels

and that they are pure referencing expressions, are evaluated in the light of the

data reported in this thesis.

Chapter 3

Validating the model of proper name processing

According to the model by Valentine *et al.* (1996) the representation of conceptual knowledge is separate from lexical representations, and the first stage of lexical access, the semantic lexicon, is common to input and output (See Figure 1 on page 35). Separate processing routes are specified for visual and auditory word recognition, object recognition and face recognition. Each token marker (PIN) serves as an amodal gateway to the semantic system, allowing access to identity-specific semantic information for each known person. Retrieval of proper names is difficult because access to a person's name is only achieved via a single link from the token marker (PIN) to the 'lemma' which represents their name. In contrast, access to common names from the semantic system occurs via multiple connections from units that represent the semantic features of a concept, directly to the relevant 'lemma'.

The Generic versus Specific Hypothesis

Durso and O'Sullivan (1983) suggested that differences between common names and proper names occur as a function of the specificity of knowledge evoked by these types of items. Durso and O'Sullivan also reported that proper names yielded superior recognition and recall compared to common names. These claims do not correspond to more recent research, which suggests that proper names are often more difficult to recall than other forms of noun. For example, it has been found that recall of a famous person's occupation is superior to recall of

their name (McWeeny, Young, Hay & Ellis, 1987; Cohen, 1990). Furthermore, Durso and O'Sullivan (experiment 1) reported that proper nouns produced cross-domain facilitation from a picture naming task to a word naming task. They interpreted this result in terms of the generic-specific hypothesis. Durso and O'Sullivan claimed that facilitation occurred as a function of the relationship between representations activated by visual and verbal stimuli. They argued that there will be much overlap between the semantic representations activated by a picture and the representations activated by the name of an entity that takes a proper name, because the referent of a proper name is highly specific. In contrast, the representations activated by a common name will be less specific, and therefore overlap less, with the semantic representations activated by a picture of the concept. The greater similarity in the verbal and visual representations of the referents of proper names was assumed to produce a facilitation from naming a picture to reading a word that is restricted to proper names.

In contrast to Durso and O'Sullivan's predictions, the Valentine *et al.* (1996) model does not predict any greater facilitation of naming written proper names from a prior picture naming task, than would be found for common names. The model predicts facilitation when a word naming task is conducted on two consecutive occasions because the same processing pathway is used on each occasion. However, when a picture naming task is followed with a word naming task the only link that is activated during both tasks is that between the semantic (lemma) and phonological (lexeme) levels of lexical access. This is true for production of both common names and proper names. Therefore, the model

predicts that facilitation should be equivalent for both classes of noun. Previous research suggests that a common pathway between the lemma and lexeme may not be sufficient to produce a significant effect of repetition priming in the typical experimental paradigm used for such studies (Valentine, Moore & Brédart, 1995). Data indicates that the effects of repetition from seeing a full name on a subsequent face naming task, occurs prior to lexical access. The effects cannot be attributed to articulation or phonological access as no effects of repetition occur when the same phonology is produced in response to reading a common name (Valentine et al 1996).

Durso and O'Sullivan's (1983) design is subject to a number of criticisms. First, a small number of stimuli were used in a within-participants design. The critical primed items consisted of only a small number of stimuli. Twelve items were presented as pictures, three exemplars from four different sub-categories (people, states, foods, animals). An error rate of 11% was reported for the proper name stimuli. Therefore some cell means were calculated from only two items. Second, no filler items were included during the prime phase or the test phase of the experiment. Filler items are usually considered necessary to discourage the strategy of using episodic recall to facilitate the processing of the primed items. Durso and O'Sullivan showed that the proper name stimuli were more easily recognised and remembered compared to the common name stimuli (Durso & O'Sullivan, experiments 2 and 3). This finding may indicate that the nature of the proper name stimuli may have encouraged the use of episodic recall strategies. Third, the different categories of stimuli were not matched in terms of word length or numbers of phonemes. An examination of their stimuli shows that proper

names were selected from the categories of famous people (predominantly two word names) and states of America (predominantly one word names), whereas the common names were selected from the categories of food and animals (both predominantly one word names). We conducted an analysis of variance that showed there were significant differences between the word categories in terms of word length (calculated as the number of letters; $F(3,32) = 9.1$, $p < .01$). Peoples names (mean = 10.4, sd = 2.4) were significantly longer than names of foods (mean = 6.7, sd = 1.9), names of animals (mean = 5.2, sd = 2.4) and names of states (mean = 7.2, sd = 1.8). Therefore differences in word length may contribute to Durso and O'Sullivan's finding that people's names took longer to produce than common names. Word length may not be such a problem for Durso and O'Sullivan's state names, as the mean length for state names is similar to the common name stimuli. However, the original data may still be problematic due to the large error rate and the small number of stimuli per cell.

In view of the generic-specific hypothesis that Durso and O'Sullivan set out to test, it would not have been appropriate to attempt to eliminate episodic recall as a strategy in their experiments. The Valentine et al. (1996) model is incompatible with an *abstractionist* account of proper-name-specific facilitation between picture naming and word naming. However, if the facilitation in Durso and O'Sullivan's experiment is episodically mediated it could not be considered to provide a test of the model. Therefore, it is essential to establish whether proper-name-specific facilitation can be found in an experiment designed to reduce the role of episodic mediation of facilitation to a minimum.

The current experiments investigated the potential for a picture naming task to prime a subsequent word naming task when the role of episodic mediation is minimised. Experiment 3.1 included different categories of proper name and common names, in an attempt to replicate the category-specific priming reported by Durso and O'Sullivan (1983). Experiment 3.2 focussed exclusively on landmark names. In each case, a number of methodological improvements were made to the design of the original Durso and O'Sullivan (1983) experiment. First, a larger number of stimuli were employed in a mixed-factorial design. Two sets of stimuli were matched on word length, and the presentation of experimental and control sets of items were counterbalanced. Second, distracters were included to make recall of prime items more difficult. In accordance with the Valentine *et al.* (1996) model and the results of Valentine *et al.* (1995) the hypothesis for Experiment 3.1 was that priming from a picture naming task onto a word naming task was not expected.

Experiment 3.1

Method

Design

The experiment was a mixed factorial design. It consisted of two phases, a prime phase followed by a test phase. During the prime phase participants performed either a picture naming task or a word naming task. Prime task was therefore a between-participants factor. The test phase consisted of a word naming task for both groups. The experimental stimuli were drawn from three different categories. The effect of noun category was a within-participants factor (people, places, objects). There were two sets of thirty critical items. One of these sets

appeared in both the prime phase and the test phase. Responses to this set of items formed the data for the primed items. The other set of thirty critical items appeared only during the test phase. Responses to this set of items formed the data for the unprimed (control) condition. The effect of priming (primed, unprimed) was also a within-participants factor. With the exception of the primed items, no other stimuli were repeated between the prime phase and the test phase. The assignment of items to the primed and unprimed conditions was counterbalanced across participants for each experimental condition.

Participants

Forty-three people participated in the experiment. Data from forty participants contributed to the final analysis (five males and thirty-five females; Mean age = 23 years, range 19 - 40). Three participants in the picture naming condition were replaced because their performance included errors of sixty percent or more for the naming of people or landmark picture items. All of the participants were students at Goldsmiths College, University of London and received a course credit for participation.

Stimuli

Sixty stimuli were selected as critical items. A further sixty-nine items were used as filler and practice items. The items were members of the following categories of proper names and common names: proper name stimuli were taken from categories of famous people (e.g. Ruby Wax, Joanna Lumley) and famous landmarks (e.g. Big Ben, Taj Mahal). As the experiment was to be conducted in the United Kingdom, States of America were not considered appropriate. The

common name stimuli were derived from everyday objects (e.g. coat hanger, filing cabinet).

The stimuli were subdivided into two matched sets of ten critical items (see Appendix 1). The remaining items acted as fillers. The critical items from each category were matched for word length (number of letters). The word length (mean no. of letters with standard deviations in parentheses) of critical items were: people 11.5 (2.4); landmarks 11.1 (2.9); objects 10.9 (1.7); There was no difference in the mean word length for either set of critical items of any category of noun, $F(2,54) < 1$. A 6cm x 6 cm black and white digitised image of each item was produced. Written names were presented in uppercase 14pt Arial font.

Apparatus

The stimuli were presented on the screen of a PC. The presentation of the stimuli and collection of data were programmed using Micro Experimental Laboratory software (MEL2) giving millisecond accuracy. The naming responses were recorded by a throat microphone attached to a voice key.

Procedure

All participants carried out a prime task followed by a test task. In each task the experimental trials were preceded by twelve practice trials. Participants were told that they would see an item appear on the screen and the task was to name the item out loud, as quickly and as accurately as possible. Each trial consisted of a 250 msec tone followed after 500 msec by presentation of a stimulus. Stimuli were presentation in a random order. The participants' response terminated the

display of the stimulus. The experimenter recorded the accuracy of the vocal response by entering a key press onto the keyboard. Responses were considered correct if the participants produced the full name of the item accurately. Errors included incomplete responses and occasions when the voice key misfired. The following trial commenced after the experimenter had logged the response accuracy by making a key-press on the keyboard. The prime phase consisted of thirty critical items to be primed (ten items from each category) together with thirty filler items (ten from each category), in either the pictorial or verbal format. The test phase consisted of the thirty primed items and thirty unprimed (control) items together with fifteen filler items (five items from each noun category).

Results

Responses to the critical 'primed' and 'unprimed' items made during the test phase were subjected to analysis. A response to an item was only included in the analysis if the correct name was given in both the prime phase and the test phase. Mean reaction times for correct responses are shown in Figure 3.1. The percentage error rates can be found in Table 3.1. Error rates were not subjected to any further analysis.

Figure 3.1 Mean RT for word naming during test phase as a function of prime task and noun category. Shown with 95% confidence interval for the within-participants effect of priming
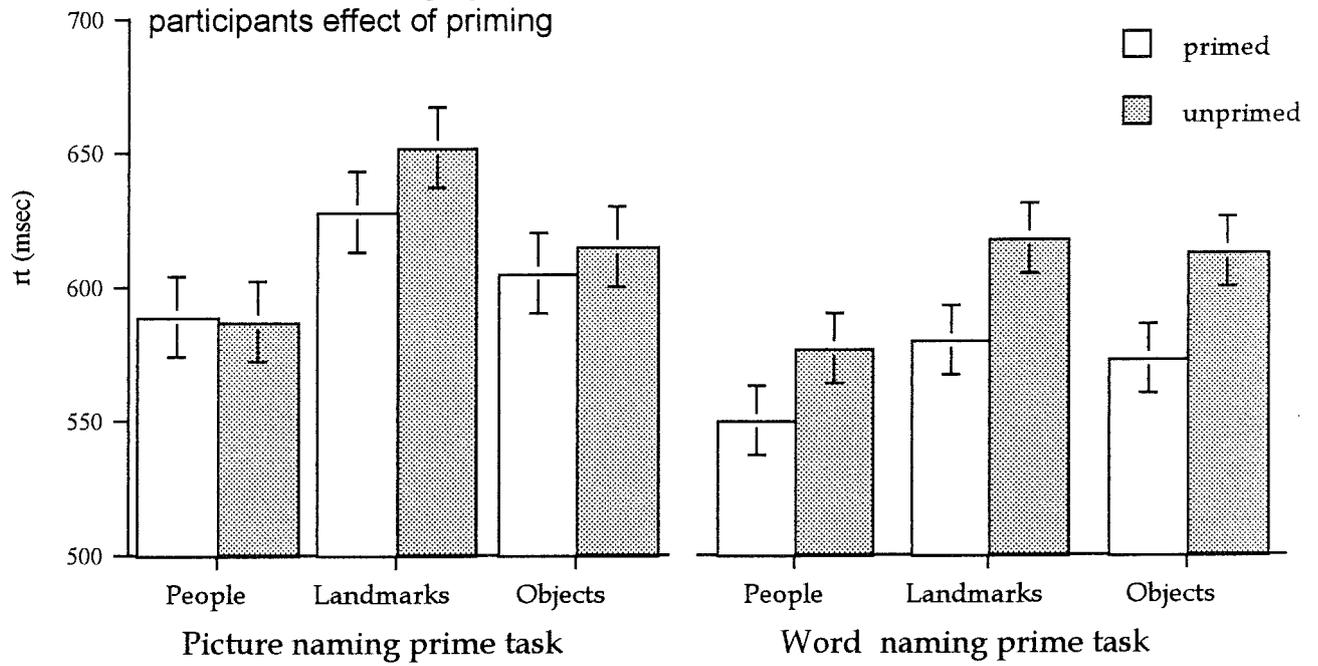
Table 3.1 Error Rates and Mean RT for Experiment 3.1.

Noun Category &	People		Landmarks		Objects	
Condition	Primed	Unprimed	Primed	Unprimed	Primed	Unprimed
Picture Naming						
Mean RT (msec)	589	587	628	652	605	615
SD (msec)	73	86	105	98	76	88
Error %	8	1	12	3	5	4
Word Naming						
Mean RT (msec)	550	577	580	618	573	613
SD (msec)	70	85	73	105	76	92
Error %	0	3	2	4	3	4

The data were analysed by participant, with repeated measures on the priming and noun-category factors and taking prime task as a between-participants factor (identified by the suffix 1), and also by item taking priming and prime task as a within-items factor with noun-category as a between-items factor (identified by the suffix 2).

The mean response time in the test task following picture naming in the prime phase (612 msec) was slower than the mean response time following word naming in the prime phase (585 msec). This main effect of prime task was not significant for participants $F_1(1,38) = 1.22$, p>.05 but was significant by items $F_2(1,57) = 15.81$, p <.01. There was a main effect of noun-category $F_1(2,76) = 22.63$, , p <.01; $F_2(2,57) = 3.6$, p <.05. The mean response time to peoples names (575 msec) was faster than the mean response times to the other categories of noun (landmarks 619 msec; objects 601 msec). There was a main effect of priming $F_1(1,38) = 23.75$, p <.05; $F_2(1,57) = 14.3$, p <.01. Primed items produced faster responses (mean 587msec) than unprimed items (610 msec). The prime by task interaction was significant $F_1(1,38) = 6.7$, p <.01; $F_2(1,57) = 5.8$, p <.01. Greater facilitation was produced following the word naming prime task, compared to the picture naming prime phase. No other effects were significant (All F's < 1.3).

The interaction between prime and task was further explored by separate ANOVA's for each prime task separately. In respect of the picture naming prime task, neither the main effect of priming $F_1(1,19) = 2.34$, p = .14; $F_2(1,57) = 2.55$, p =.08 nor the interaction between noun-category and priming was significant $F_1(2,38) = 1.25$, p =.29; $F_2(2,57) = 2.5$, p =.08. In view of the current predictions and Durso and O'Sullivan (1983, experiment 1) who had previously reported a noun-category by prime interaction that was significant only for the category of proper names, this interaction was explored using simple main effects. The effect of priming at specific levels of noun-category was significant only for the sub-category of landmarks when analysed by item $F_2(1,57) = 7.76$, p <.01. (For other comparisons, F_1's < 2.56; F_2's <1.) In respect of the word naming prime

task there was a significant main effect of priming $F_1(1,19) = 31.45$, $p<.01$; $F_2(1,57) = 20.2$, $p<.01$. The interaction between noun by priming was not significant $F_1(2,38) < 1$; $F_2(2,57) < 1$,.

Discussion of Experiment 3.1

The data from common (object) names is consistent with that of Durso and O'Sullivan in that there was no facilitation of reading aloud an object's name from having previously named a picture of the object. These results differ from Durso and O'Sullivan's in that no evidence was found of any facilitation of reading aloud a celebrity's name from having named a celebrity's face. These aspects of the results are very clear. The data from landmarks are slightly less clear. In this case, there was a trend towards priming from picture naming that was statistically significant only in the by-items analysis. It would be incautious to conclude there was category-specific priming from picture naming on the basis of this result as the effect does not generalise across participants. This cannot be attributed to lack of power in the experimental design because reliable priming was found for all stimuli when participants read words aloud in both phases of the experiment. The likely explanation for this trend lies in the strategy of excluding data from items that were not correctly named in both phases of the experiment. Inspection of Table 3.1 shows that the landmarks were the most difficult pictures to name, yielding an error on 12% trials. The majority of these errors arise from picture naming errors rather than errors in the test phase (cf. 3% error rate for unprimed items). The effect of the relatively high error rate will be to exclude data from the less familiar items from calculation of mean 'primed' reaction times, thereby producing a trend towards a priming effect as an artefact of the data analysis.

This account is consistent with the effect being significant only in the by-items analysis. If the correct responses (considering the accuracy during the test phase only) to landmark stimuli are subjected to a related t-test, no significant facilitation is found for analysis by participant or item $t_1(19) = .98$ $p = .1$, $t_2(19) = .42$ $p = .33$.

Experiment 3.2 aimed to confirm whether picture naming of landmark stimuli would facilitate a subsequent word naming task. Two alternative sets of critical items were formed that were considered to produce more reliable responses in the picture naming prime task.

Experiment 3.2

Experiment 3.2 aimed to determine whether picture naming could prime a subsequent word naming task. In accordance with the model by Valentine et al. and previous results, it is predicted that no facilitation would be found when a picture naming task is followed by a subsequent word naming task. In contrast, facilitation should occur when a word naming task is followed with a subsequent word naming task.

Method

Design

In accordance with Experiment 3.1, this experiment consisted of two phases, a prime phase followed by a test phase. During the prime phase participants performed a picture naming task, or a word naming task. The test phase

consisted of a word naming task for both groups. The experiment was therefore a mixed factorial design. The effect of priming (primed, unprimed) was a within-participants factors. Prime task was a between-participants factor. There were two sets of nine critical items. One of these sets appeared in both the prime phase and the test phase. Responses to this set of items formed the data for the primed items. The other set of nine critical items appeared only during the test phase. Responses to this set of items formed the data for the unprimed (control) condition. With the exception of the primed items, no other stimuli were repeated between the prime phase and the test phase. The assignment of items to the primed and unprimed conditions was counterbalanced across participants for each experimental condition.

Participants

Thirty two people (three males and twenty-nine females; Mean age = 37 years, range 28 - 50) participated in the experiment. All of the participants were students of the Open University attending residential school. None of the participants had taken part in Experiment 3.1.

Stimuli

For the prime phase, forty items were chosen. Eighteen pictures of famous places were selected as critical items. The stimuli were subdivided into two matched sets of nine critical items (see appendix 2). The names of the two sets of critical items were matched for word length (Set A mean number of letters 9.8,

s.d. 2.6; Set B mean number of letters 11.7, s.d. 3.0; t(16) = 1.42, p = .17). A further thirty-one pictures of recognisable places were selected as filler items. All pictures were black and white photographs measuring 6cm x 6cm. Each set of forty pictures was inserted into a booklet in a random order.

For the test phase a series of written names were formed. Eighteen names corresponded to the critical items. A further seven familiar items were selected as fillers. Twenty five plausible, but unfamiliar place names (e.g. Emma's Park, Clumber Monument) were formed. An additional ten items (five familiar and five unfamiliar) served as practice items. Words were presented visually in 14 point Ariel Font, at the centre of the visual display.

Apparatus

The stimuli for the test phase of the experiment were presented on the screen of a Macintosh computer. The presentation of the stimuli and collection of data were programmed using Superlab software. The naming responses were taken with a microphone attached to a voice key.

Procedure

All participants carried out a prime task followed by a test task. Participants were told that they would see a series of pictures (or names) of famous places from around the world and they should produce the name of the place as quickly as possible. The prime phase consisted of nine critical items to be primed together with thirty one filler items. The prime phase series were presented in one of four

alternative pseudo-randomised orders. The test phase was then presented on Macintosh computer. The trials were preceded by ten practice trials. The test phase consisted of fifty items in total: the nine primed items, nine unprimed (control) items together with seven filler items, and twenty-five unfamiliar items, in random order. Each trial consisted of a 250 msec fixation, followed after 500 msec by presentation of a stimulus. Participants were told that they would see an item appear on the screen and the task was to read the name and say it out loud, as quickly and as accurately as possible. The participants' response terminated the display of the stimulus. The experimenter recorded the accuracy of the vocal response by entering a key press onto the keyboard. The following trial commenced after the experimenter had logged the response accuracy by making a key-press on the keyboard. Responses were considered correct if the participants produced the full name of the item accurately. Errors included incomplete responses and occasions when the voice key misfired.

Results

Responses to the critical 'primed' and 'unprimed' items made during the test phase were subjected to analysis. A response to an item was only included in the analysis if the correct name was given in both the prime phase and the test phase. Figure 3.2 below illustrates the mean reaction times for correct

responses. The percentage error rates can be found in Table 3.2. Error rates were not subjected to any further analysis.

Figure 3.2: Mean RT during test phase as a function of prime condition and task (shown with 95% confidence Interval for the within participants effect of priming).
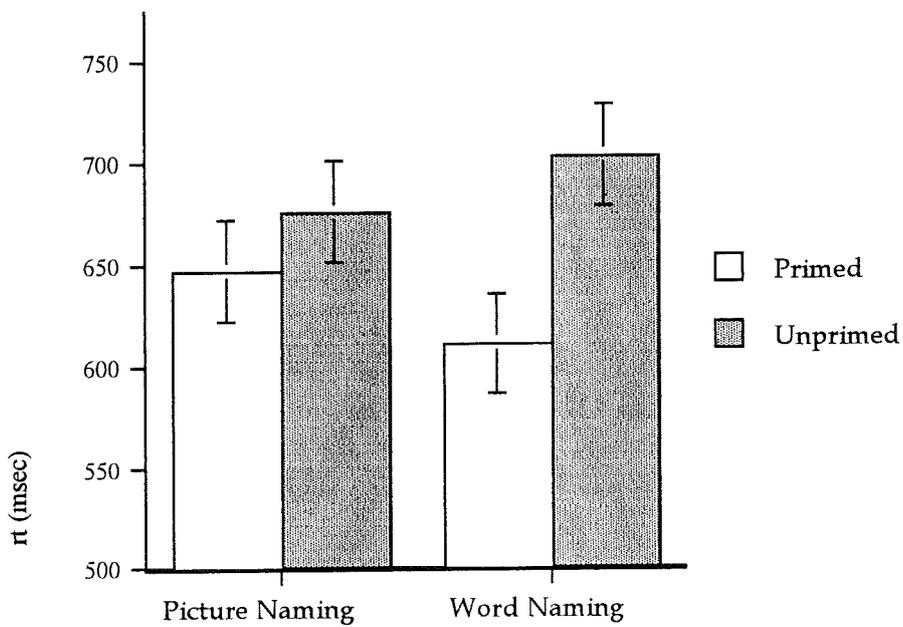
Table 3.2 Error Rates and Mean RT for Experiment 3.2.

Noun Category & Condition	Landmarks	
	Primed	Unprimed
Picture Naming		
Mean RT (msec)	**647**	**676**
SD (msec)	110	146
Error %	3	1
Word Naming		
Mean RT (msec)	**611**	**704**
SD (msec)	106	121
Error %	3	2

The data were analysed by participant, with repeated measures on the effect of priming with prime task as a between-participants factor (identified by the suffix 1), and also by item taking priming and prime task as a within-items factor (identified by the suffix 2). The main effect of prime task was not significant F_1 (1,30) < 1; F_2 (1,17) < 1. There was a significant main effect of priming F_1 (1,30) = 19.40, p < .01; F_2 (1,17) = 17.86, p < .01. The interaction between prime task

and priming was significant in the participants analysis, and approached significance in the items analysis. F_1 (1,30) = 4.60, p < .05; F_2 (1,17) = 19.06, p = .06. As the hypothesis concerned differences in priming for each of the prime tasks, simple main effects were used to explore the interaction. The effect of priming was significant for the word naming prime task F_1 (1,30) = 21.50, p < .01; F_2 (1,17) = 19.06, p = .01. In contrast the effect of priming was not significant for the picture naming task F_1 (1,30) = 2.53, p =.12 ; F_2 (1,17) = 2.59, p = .12.

Discussion of Experiment 3.2

Experiment 3.2 indicated that producing the name of a landmark from a picture did not reliably facilitate a word naming task. The lack of facilitation cannot be attributed to a lack of power as significant facilitation was found following the word naming prime task. The error rates in the current experiment were much lower than those found in Experiment 3.1, and therefore the picture naming prime task can be considered more reliable. The present data suggest that the interpretation of Experiment 3.1 was indeed valid, as no significant priming occurred following the picture naming prime task .

General Discussion of Experiments 3.1 and 3.2

The experiments reported in this chapter address evidence reported by Durso and O'Sullivan (experiment 1, 1983) . Durso and O'Sullivan found that naming a picture of a proper name primed a word naming task. These are important issues to investigate, because any cross-domain priming that is specific to proper names and requires an abstractionist account would undermine the Valentine *et al.*

(1996) model. This model cannot account for any differences in cross-domain priming of word naming between proper names and common names. I argued that Durso and O'Sulivan's findings may have been an artefact of the experimental design, occurring due to the experimental stimuli and retrieval of an episode. This is very likely as Durso and O'Sullivan's later experiments found that the proper name stimuli were highly memorable compared to the common names. If Durso and O'Sullivan's study is to be taken to invalidate the model proposed by Valentine, Brennen and Brédart (1996) then episodic effects must first be eliminated. Experiments 3.1 and 3.2 indicate that when an experimental design is formed to eliminate episodic influences, there was no statistically significant cross-domain priming from a picture naming task onto a word naming task.

Picture naming and word naming do require activation of a common link, from the lemma to the lexeme. As repetition priming is assumed to reflect a strengthening of a link from recent use, why is cross-domain priming of word naming not observed for all stimuli? The model by Valentine *et al.* (1996) provides two routes by which a lexeme can be activated from a written word. A lexical route via the semantic lexicon and a sub-lexical route via orthography to phonology conversion strategies. The activation of the lexeme would be given by a summation of activation passed via both pathways (Hillis & Caramazza, 1991). Picture naming would strengthen only the lemma – lexeme link. In contrast, participants who read aloud the items during the first phase of the experiment would have primed both pathways. Therefore, a much greater effect of repetition priming would be predicted from word naming than from picture naming. This prediction was

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confirmed. Neither the model nor the data reported here, exclude the possibility that priming of word naming from picture naming could be found with a more powerful experimental design. However, we can conclude that any effect is much weaker than the effect of priming of word naming from the same task. The model predicts that if an effect could be observed it should be equivalent for common names and proper names.

The results reported here are consistent with an account in terms of transfer appropriate training and perceptual fluency: the priming is only observed when the stimulus is repeated in the same modality and when the processing task is the same. The aim of the experimental design was to reduce the possibility that cross-domain priming could be mediated by retrieval of the priming episode. Clearly this aim has been achieved as no robust cross-domain priming was observed in Experiment 3.2. Nevertheless the word naming prime demonstrates that both of the experimental designs had sufficient power to detect repetition priming when it is present.

There will always be a number of possible explanations of priming when the prime and test tasks are identical and the stimulus is presented in the same domain. However, it has been demonstrated that when an experiment is designed appropriately the data are consistent with an abstractionist account in general and with the Valentine et al. (1996) model in particular.

Chapter 4

Cross-modal Facilitation

As discussed in the chapter on methodology, it has been suggested that changing the format in which a particular stimulus is presented reduces the facilitation produced by repetition. Less facilitation (but significant priming) has been found for visually presented words in a variety of tasks such as word fragment, stem completion, lexical decision, degraded word identification, and if the prime phase has been conducted in the auditory modality (Graf, Shimmura & Squire 1985; Hashtroudi, Ferguson, Rappold & Chronsniak 1988; Roediger & Blaxton, 1987; Scarborough et al., 1979). However, there is some disagreement concerning the degree to which facilitation can transfer from one modality or domain to another.

A number of studies have found little or no benefit to subsequent processing if the modality or domain is changed between prime and test. For example, Jacoby and Dallas (1981) report no significant cross-modal priming from an identification task for brief presentations following an auditory prime compared to a visual prime. Morton (1979) was unable to find priming in a visual identification task, when the prime phase was conducted in the auditory modality followed by a test phase in the visual modality. However, priming (but less facilitation than when the same task was repeated) was found if the prime phase was a visual task and the test phase was an auditory task that involved the identification of words in background noise. Ellis (1982) found that identification of words

presented in noise yielded greater accuracy when prior experience of the word had been in the auditory modality. No facilitation occurred if the prime phase was conducted in the visual modality. Clarke and Morton (1983) assert there is little benefit from a previous encounter when the tasks at prime and test crossed modality. Jacoby and Dallas (1981) found that visual identification of tachistoscopic presentations of word stimuli, were only facilitated when prime and test were of the same modality. A total absence of cross modal facilitation, such as this, is supportive of the episodic account of priming. However, other studies have shown that facilitation does sometimes transfer between stimulus modality. For example, Jackson and Morton (1984) found less priming for the identification of auditory words in noise following visually presented words during the prime phase compared to when the prime phase was conducted in the auditory modality. Bassili, Smith and MacLeod (1989) found similar results when participants were required to complete auditory word stems when the prime phase had been conducted as a visual presentation. Weldon (1991) asserts that priming occurs for the identification of a tachistoscopic presentation of a visual word following previous experience of that word in the auditory modality, but the facilitation was significantly less than when participants received both the prime phase and the test phase in the same modality. Kirsner and Smith (1974) and Kirsner, Milech and Standen (1983) investigated cross-modal priming using the lexical decision task, to find that cross-modal designs produced significant facilitation, however, this was significantly smaller than found with within-modality priming. They suggested that this suggested two loci of facilitation existed, a modality-specific facilitation which they attributed to activation at the perceptual stages of processing and a modality-free facilitation attributed to semantic

access. Hunt and Toth (1990) and Weldon (1991) found cross-modal facilitation occurred for a visual word fragment completion, but presenting the prime phase in the same modality as test produced significantly larger facilitation.

In summary, differences in empirical findings may relate closely to the differences in the experimental tasks; tasks that have high processing demands (such as identification in noise and fragment completion) appear more likely to produce cross-modal facilitation. When cross-modal facilitation does occur, the magnitude of facilitation is much smaller than that of a comparable, within-modality presentation.

One recent finding is that people's names evince a different pattern of long term repetition priming phenomena compared to common names (Valentine, Hollis & Moore, 1998). A series of experiments indicated that people's names produced cross-modal facilitation from an auditory name familiarity decision to a visual name familiarity decision. The magnitude of this cross-modal facilitation was similar to within-modality priming. Cross-modality priming did not occur when common names were presented in a lexical decision task. These findings are interesting as the previous discussion has indicated that changing the modality of presentation between training and test is usually considered to reduce or eliminate facilitation (e.g. Scarborough, Gerard & Cortese, 1979). However, these findings are perfectly in keeping with the model proposed by Valentine et al. (1996). Repetition priming is considered to reflect an increase in a connection weight between different representational levels following prior processing. Processing via the highly specific token marker-lemma linkage is

required for any tasks involving person identity (such as the name familiarity decision). During the name familiarity decision, activation must flow via the word recognition unit via the lemma to the token marker. The name familiarity decision tasks require access to the token marker during the prime phase and the test phase in order to successfully make the decision (see Figure 1, p.35). Consequently the model predicts facilitation in an abstractionist (item-specific) fashion for people's names. In contrast, for common names a lexical decision is made at the level of the lemma and does not require access to token marker. The processing during the prime and test phase does not involve the same processing route and so no facilitation occurs for common names during lexical decision. It is possible that repetition priming can occur due to the retrieval of a prior processing episode, found in the perceptual fluency and transfer-appropriate processing accounts of priming as discussed in Chapter 2 (Jacoby & Dallas, 1981; Roediger & Blaxton, 1987). However, the experiments reported in this chapter were designed to minimise the influence of episodic retrieval. Hence, the patterns of data found are difficult to account for in terms of an episodic explanation.

All of the experiments in this chapter used a cross-modal repetition priming paradigm. The aim of this research was to determine whether the previous findings of Valentine et al. (1998) could be replicated and extended to other classes of proper name. A contrast was made between the long term priming of people's names, landmark names and country names (proper names) with object names (common names). In the prime phase, names were presented in

either the visual or auditory modality. In keeping with the study by Valentine et al. (1998) proper name stimuli were presented as a familiarity decision task. The methodology and rationale were adapted from Valentine et al's (1998) study of people's names. Experiment 4.1 compared a familiarity decision to people's names, landmark names and country names to a task in which a lexical decision was made to common names. The second experiment (Exp. 4.2) compared cross-modal facilitation for landmark names and country names, to determine whether the data from Experiment 4.1 was robust. Experiment 4.3 investigated whether the cross-modal effects related to name frequency by comparing high and low frequency common names that were presented for name familiarity decision. Experiment 4.4 investigated whether the cross-modal effects related to conceptual specificity by comparing a base level name with a sub-ordinate level name. Finally, Experiment 4.5 addressed the issue of adjectivisation using city names as stimuli. Similar processing for all proper names would be expected if all sub-categories of proper name are considered to have a similar cognitive architecture. Variations in the processing of sub-categories of proper name may indicate that differences in their representation exist. It may also provide a basis for choosing between theories of uniqueness, meaninglessness, and token reference.

Experiment 4.1

The model by Valentine et al. (1996) predicts that for people's names stimuli, cross-modal priming should occur. This prediction occurs due to the nature of connectivity between the token marker and the lemma for people's names. Once a person's name has activated the appropriate lemma, the name familiarity decision task requires access to the token marker. The linkage between the

lemma and the token marker involves the same processing pathway irrespective of the modality of presentation. As both the prime task and test task require processing from the lemma to the token marker, facilitation should be observed. Valentine et al. (1998) showed that repetition priming of a familiarity decision to people's names crossed stimulus modality. They also showed that no cross-modality priming occurred when common names were presented in a lexical decision task. In this regard, common names (object names) presented for lexical decision were also included in the current study. Many authors have used the familiarity decision task as an analogue to the lexical decision task (Bruce, 1983; Ellis et al.,1982 ; Valentine, Ellis, Moore, Flude 1993; Bruce & Valentine, 1985; Bruce & Valentine, 1986; Bruce & Young, 1986). However, we are not assuming the comparability of familiarity and lexical decision task. Rather, the lexical decision to object names was included as Valentine et al. (1996) predicts that no cross-modal facilitation would be observed for object names presented as a lexical decision task. This prediction emerges as the processing from name recognition units to the lemma are modality specific. Lexical decisions are assumed to be made at the lemma level of representation and do not require access to a token marker. Therefore, no processing pathways are common to both the prime phase and the test phase of the experiment. In this case, no cross-modal facilitation is expected for object names presented as a lexical decision task. The aim of this experiment was to replicate the cross-modal facilitation for people's names and determine whether the finding would generalise to other classes of proper name (names of landmarks and countries).

Method

Participants

One hundred and eleven participants (27 male and 85 female) took part in the experiment. The age of participants ranged from 18 to 50 years with a mean age of 27 years.

Stimuli

For each noun category, two sets of 9 critical items were constructed (see Appendix 3). There was no significant difference between the word length of the two stimuli sets. In addition, for each noun category 23 filler items, 50 unfamiliar items and 20 practice items were also selected. In respect of people's names, the critical and filler items were names of well known celebrities (e.g. Ruby Wax, Margaret Thatcher). The unfamiliar items were plausible unfamiliar names (e.g. Mark Jones).

For the category of landmarks, the critical items were names of famous landmarks (e.g. Big Ben, Statue of Liberty). The names were selected from a pilot study in which different participants were asked to name a series of famous landmarks. The most reliable items were selected as critical items in the present study. Additional items were chosen as filler famous (e.g. Regents' Park) and plausible unfamiliar items (e.g. Harry's Column, Statue of Day). In respect of country names, the critical and filler items were names of well known countries (e.g. Spain, France). As before, a set of pronounceable unfamiliar names were formed (e.g. Nobleland, Cettius, Gallaport).

For the lexical decision task with common names, the critical and filler items were names of familiar objects (e.g. butterfly, candle). A selection of pronounceable non-words were produced to act as unfamiliar items (e.g. gormil, famern).

Apparatus

For the visual presentations, stimuli were presented on the screen of an IBM compatible computer. The experiment was produced using Micro Experimental Laboratory (MEL2) which records responses with millisecond accuracy. The participants' responses were recorded using key presses on the keyboard. For the auditory presentation of the prime task, stimuli were presented in random order via headphones from a cassette tape recorder. The participant made a response by pressing one of two keys on a hand held response box. An LED indicator enabled the experimenter to monitor the accuracy of the responses, which were recorded manually.

Design

The experiment had a mixed design with three factors: modality of the prime phase task (visual, auditory) and category of noun (people, landmarks, countries, objects) were between-participants factors. The effect of priming (primed, unprimed) was a within-participants factor. There were two sets of 9 critical items for each category of noun (see appendix 3). One of these sets appeared in both the prime phase and the test phase. Responses to these items formed the data for the primed items. The other set of 9 critical items appeared only in the test phase. Responses to these items formed the data for the

unprimed (control) items. With the exception of the primed items, no other items were repeated between prime and test. The assignment of items to the primed and unprimed conditions was counterbalanced across participants for each experimental condition.

The experiment consisted of two phases, a prime phase and a test phase. All participants carried out a familiarity decision with a single category of stimuli during both the prime phase and the test phase. Each participant received a prime phase in either the visual or the auditory modality, followed by a test phase. Each participant received the test phase in the visual modality. There were 28 participants for each noun category, 14 received the visually presented prime task, and 14 received the auditory presented prime task.

Procedure

Participants were assigned to one of the four noun category groups (people, landmarks, countries, objects). Participants who received the peoples' names, landmark and country name stimuli, were required to perform a familiarity decision. Participants who received the object names were required to perform a lexical decision. In each case participants received a prime phase followed by a test phase, however, they were not informed that the experiment consisted of two stages. Prior to each phase ten practice trials were given. The prime phase consisted of a total of 50 stimuli: (9 primed critical items, 16 filler famous items, and 25 unfamiliar items). For the visual presentations, each trial consisted of a 250 ms tone followed after 500 ms by presentation of the stimulus in upper case 14pt Arial font in the centre of the visual display. The participant's response terminated the display of the stimulus. Each participant saw a different random

order of stimuli, and was required to make a decision as quickly and as accurately as possible. For the auditory prime phase, stimuli were presented via headphones from a cassette tape recorder. Two different random orders of stimuli were constructed for each set of primed and unprimed items. In each trial, a name was presented and participants were instructed to make a decision by pressing 'yes' or 'no' on the keyboard. Participants were instructed to respond as quickly and as accurately as possible. The experimenter recorded the accuracy of the participants' responses manually.

The test phase consisted of 50 stimuli (9 critical items (primed), 9 control items (unprimed), 7 filler famous items and 25 unfamiliar items) and was presented visually to all participants. Only the 9 critical (primed) items were repeated between the prime phase and the test phase of the experiment. The procedure and presentation was the same as in the visually presented prime phase.

Results

Responses to the nine critical primed and unprimed items made during the test phase were analysed. A response to an item was only included in the analyses if the correct response was given in both the prime and the test phase. The accuracy and timing of responses is given in Table 4.1. A proportional facilitation score was calculated for each data point (unprimed RT - primed RT/ unprimed RT). The proportional facilitation scores are plotted as a function of noun type and prime task modality in the following figure(Figure 4.1).

Figure 4.1 Mean proportional facilitation as a function of noun category and prime task modality. Error bars indicate the 95% confidence interval for the effect of prime task modality.
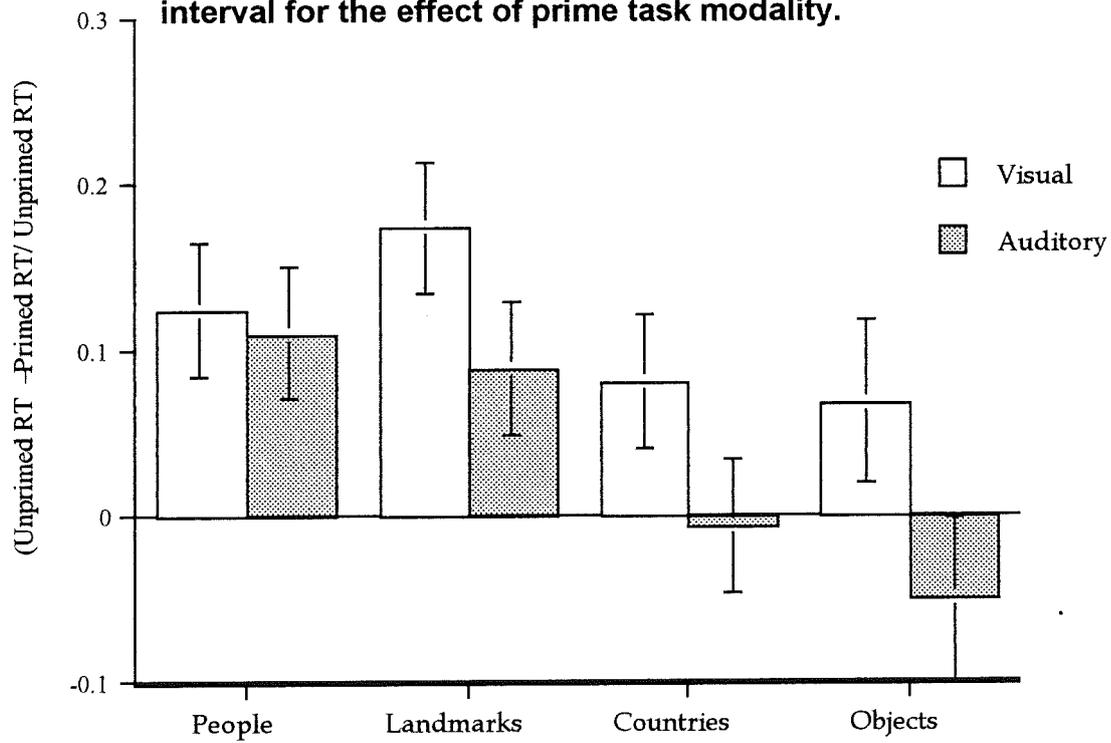
Table 4.1 Mean RT's and Response accuracy (out of 9) for Experiment 4.1.

	Primed	Unprimed
Familiarity Decision		
People's names		
Visual - Visual	638 (8.0)	729 (8.1)
Auditory - Visual	730 (8.1)	835 (7.7)
Landmark names		
Visual - Visual	641 (7.8)	756 (7.4)
Auditory - Visual	585 (7.9)	653 (7.4)
Country names		
Visual - Visual	518 (8.4)	572 (8.8)
Auditory - Visual	566 (8.8)	562 (8.9)
Lexical Decision - Object names		
Visual - Visual	536 (6.5)	577 (6.0)
Auditory - Visual	645 (8.4)	616 (8.7)

The proportional scores were subjected to an ANOVA taking participants as the random factor with prime task modality and noun category as a between participants factor (identified by the suffix 1). A separate ANOVA was carried out taking items as the random factor with prime task modality as a within items factor and noun category as a between items factor (identified with the suffix 2). The main effect of noun category was significant $F_1(3,104) = 7.70$, p < .01; $F_2(3,68) = 3.27$, p <.05. The main effect of prime task modality was significant $F_1(1,104) = 12.07$, p < .01; $F_2(1,68) = 4.17$, p <.05. The interaction between noun category and prime task modality was not significant $F_1(3,104) = 1.25$, p =.29; $F_2(3,68) = 1.22$, p = .30. As the experimental hypothesis concerned the

interaction, simple main effects were used to explore the interaction further. The effect of prime task modality was not significant for peoples names $F_1(1,104)$ = 1.24, p = .72; $F_2(1,68)$ <1. or for landmark names $F_1(1,104)$ = 2.04, p = .15; $F_2(1,68)$ < 1. Significant differences emerged for the effect of prime task modality for country names $F_1(1,104)$ = 4.75, p <.05; $F_2(1,68)$ = 3.80, p < .05 and for object names $F_1(1,104)$ = 8.92, p < .01; $F_2(1,68)$ = 4.04, p < .05.

Analyses of the raw reaction times for the auditory prime task was also carried out. For brevity an analysis only of the data for the auditory prime task is reported, taking participants as the random factor with noun category as a between participants comparison and the effect of priming as a within participants factor (identified by the suffix 1). An analysis was also carried out taking items as the random factor (identified by the suffix 2). The interaction between noun category and priming was significant $F_1(3,52)$ = 9.16, p <.01; $F_2(3,68)$ = 6.15, p < .01. Simple main effects were used to explore the interaction. There was a significant effect of priming for people's names $F_1(1,52)$ = 21.00, p <.01; $F_2(1,68)$ = 12.77, p < .01 and landmark names $F_1(1,52)$ = 18.92, p <.01; $F_2(1,68)$ = 13.93, p < .01. However the effect of priming was not significant for country names or object names (All F's < 1).

Discussion of Experiment 4.1

Experiment 4.1 aimed to test the hypothesis that proper names would produce cross-modal facilitation from a name familiarity decision presented in the auditory modality to a name familiarity decision presented in the visual modality. A further prediction was that the facilitation produced in the cross-modal

presentation would be equivalent to the facilitation from a within modality prime presentation. These hypotheses were supported for the categories of people's names and landmark names. Further comparisons determined that cross-modal facilitation did not occur for common names of everyday objects when presented for a lexical decision. In contradiction of the experimental hypothesis, no cross-modal facilitation was found for country names.

To account for the lack of cross-modal priming for country names one needs to consider the connectivity between the lemma and the conceptual system. It is likely that country names are likely to have a diffuse connectivity, from the lemma directly to the conceptual system due to the many associations of country names. The fact that they can be used as adjectives as well as nouns provide evidence of such associations. In short, country names have sense and so are not pure referencing expressions. Therefore, a familiarity decision to a country name, may depend on access to the conceptual system rather than a token marker, with activation passing from the lemma to the conceptual system directly via diffuse links. In this case, the spread of activation could by-pass the token marker-lemma link and hence no cross-modality facilitation would be found. This interpretation suggests that there are limitations for the view that all proper names are pure referencing expressions and are mediated by a token marker in memory.

There were differences in the unprimed baseline for making familiarity decision. The unprimed RT for people's name and landmark name stimuli were larger than the RT for the country name and object stimuli. There are a number of

explanations for these differences. Firstly, the model predicts that items that require processing via the token marker would have longer processing times, than items that access the conceptual system directly. The reason for this is that access to the token marker involves an extra processing stage. Indeed differences in unprimed baseline condition have been found for lexical decisions to common names and in previous studies that have employed name familiarity decisions to people's names (e.g. Valentine, Moore, Flude, Young & Ellis, 1993). Secondly, differences in baseline can be attributed simply to an effect of word length. People's names and landmark names were longer than the country and object names (see Appendix 3).

One potential confound that requires careful consideration is word frequency of the different categories of noun. I argue that it is unlikely that the cross-modality facilitation found with people's names and landmark names occurs as an artefact of name frequency. The people's names and landmark name stimuli used in these experiments were chosen from a selection of picture items that participants were able to spontaneously name. Therefore the experimental items must be relatively high in familiarity and frequency, in order for the participants to have successfully performed the task. Furthermore, it is simply not possible to equate the frequency of items between the different noun groups. Firstly, people's names and names of landmarks are lexical compounds whose members are often highly familiar, frequent words (such as Tower, Bridge, Palace). In attempting to establish the frequency of these items one must take into account both members of the compound. Therefore, establishing frequency for these lexical entries cannot be achieved in the same way as for common names.

Nevertheless, the issue of frequency needs to be addressed further. Repetition effects have been found to be influenced by frequency for common words that are presented visually when the prime and test phase presentation are conducted within the same modality. In studies with common name stimuli, an advantage for low frequency words has been found (e.g. Kinoshita, 1995; Scarborough, Cortese & Scarborough, 1977). However, an interaction between prime modality and the effect of word frequency has not been demonstrated. The possibility that differences in word frequency were responsible for the cross-modal facilitation were addressed with Experiment 4.3. Firstly, an additional experiment (Experiment 4.2) was performed to determine whether the interaction between priming and noun-category (landmark and country names) was robust.

Experiment 4.2

Experiment 4.2 aimed to replicate the findings of Experiment 4.1. If the findings were robust, then a replication of the cross-modal presentation for landmark and county name stimuli, should interact with the effect of priming. In other words, significant cross-modal priming should occur only for the landmark name stimuli.

Method

Participants

Twenty eight participants (7 male and 21 female) took part in the experiment. The age of participants ranged from 18 to 50 years with a mean age of 40 years.

Stimuli

Two sets of 9 critical items together with practice, filler and unfamiliar items for both country names and landmark names were taken from Experiment 4.1.

Apparatus

The prime task was presented in the auditory modality to all participants. The procedure remained as for the auditory prime phase of Experiment 4. The test phase was presented in the visual modality to all participants, as in Experiment 4.1 The stimuli were presented on the screen of a Macintosh computer. The experiment was produced using Superlab software (Cedrus Corporation). The participants' responses were recorded using key presses on the keyboard.

Design

The experimental design was adapted from Experiment 4.1, having a mixed design with two factors category of noun (landmarks, countries) was a between-participants factors. The effect of priming (primed, unprimed) was a within-participants factor.

Procedure

Participants were assigned to one of the noun category groups (landmarks, countries) and were required to perform a familiarity decision. The procedure was the same as the auditory prime condition for landmark and country name stimuli in Experiment 4.1. The prime phase was conducted in the auditory

modality and the test phase was conduced in the visual modality, as in Experiment 4.1.

Results

Responses to the nine critical primed and unprimed items made during the test phase were analysed. A response to an item was only included in the analyses if the correct response was given in both the prime and the test phase. The mean accuracy and timing of responses is given in Table 4.2. A proportional facilitation score was calculated for each data point (unprimed RT - primed RT/ unprimed RT). The proportional facilitation scores are plotted as a function of noun type and prime task modality in Figure 4.2.

Figure 4.2 Mean proportional facilitation as a function of noun category. Error bars indicate a 95% confidence interval for the effect of noun category.
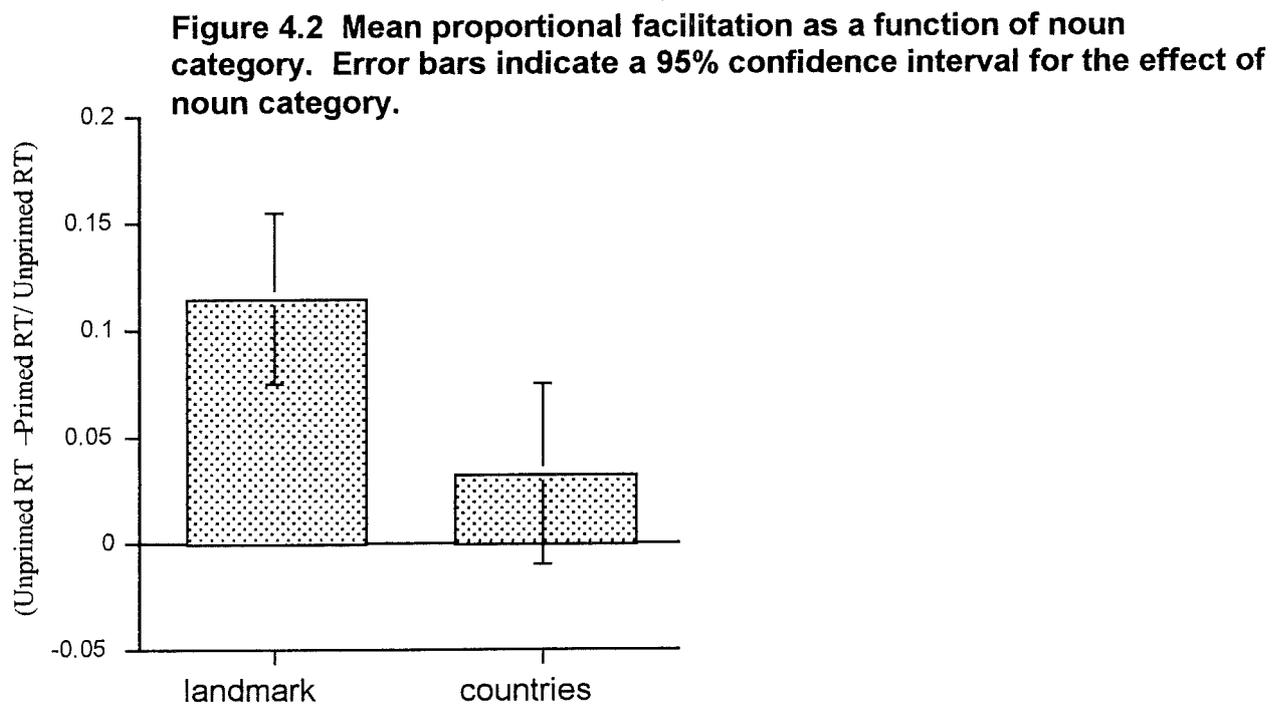
Table 4.2 Mean RT and Response Accuracy (out of 9) for Experiment 4.2.

	Primed	Unprimed
Landmark names	797 (8.2)	904 (8.3)
Country names	557 (8.9)	580 (8.9)

The proportional scores were subjected to an ANOVA taking participants as the random factor with noun category as a between participants factor (identified by the suffix 1). A separate ANOVA was carried out taking items as the random factor with noun category as a between items factor (identified with the suffix 2). Significant facilitation occurred only for the landmark name stimuli. The main effect of noun category was significant $F_1(1,26) = 4.94$ p < .05; $F_2(1,34) = 8.55$ p < .01.

Analyses of the raw reaction times was also carried out, taking participants as the random factor with noun category as a between participants comparison and the effect of priming as a within participants factor (identified by the suffix 1). An analysis was also carried out taking items as the random factor (identified by the suffix 2). The interaction between noun category and priming was significant $F_1(1,26) = 9.22$, p <.01 ; $F_2(1,34) = 4.46$, p < .05. Simple main effects were used to explore the interaction. There was a significant effect of priming for landmark names $F_1(1,26) = 29.33$, p <.01; $F_2(1,68) = 18.15$, p < 01. The effect of priming was not significant for country names (All F's < 1).

Discussion of Experiment 4.2

Experiment 4.2 confirms that cross modal facilitation occurs for landmark names but not for the country name stimuli. The data from Experiment 4.1 indicated that there were differences in the unprimed baseline for making familiarity decisions. The unprimed RT for people's name and landmark name stimuli were longer than the RT for the country name and object stimuli. Differences in the unprimed baseline have also occurred in These data (Experiment 4.2). There are a number of explanations for these differences. Firstly, the model by Valentine et al (1996) predicts that items that require processing via the token marker would have longer processing times, than items that access the conceptual system directly. The reason for this is that access to the token marker involves an extra processing stage. Indeed differences in unprimed baseline condition have been found for lexical decisions to common names and in previous studies that have employed name familiarity decisions to people's names (e.g. Valentine, Moore, Flude, Young & Ellis, 1993). Secondly, differences in baseline can be attributed simply to an effect of word length. Landmark names are longer than the country names (see Appendix 3).

However, these data raise the issue of word frequency. One potential confound that requires careful consideration is word frequency of the different categories of noun. I argue that it is unlikely that the cross-modality effect occurs as an artefact of name frequency. The landmark name stimuli used in this experiment were chosen from a selection of picture items that participants were able to spontaneously name. Therefore the experimental items must be relatively high in

familiarity and frequency, in order for the participants to have successfully performed the task. Furthermore, it is simply not possible to equate the frequency of items between the different noun groups. Firstly, names of landmarks are lexical compounds whose members are often highly familiar, frequent words (such as Tower, Bridge, Palace). In attempting to establish the frequency of these items one must take into account both members of the compound. Therefore, establishing frequency for these lexical entries cannot be achieved in the same way as for common names. Nevertheless the issue of frequency needs to be addressed further. Repetition effects have been found to be influenced by frequency for common words that are presented visually when the prime and test phase presentation are conducted within the same modality. In studies with common name stimuli, an advantage for low frequency words has been found (e.g. Kinoshita, 1995, Scarborough, Cortese & Scarborough, 1977). However, an interaction between prime modality and the effect of word frequency has not been demonstrated. The possibility that differences in word frequency were responsible for the cross-modal facilitation were addressed with Experiment 4.3.

Experiment 4.3

Experiment 4.3 investigated names derived from categories of high and low frequency. It might be argued that people's names and names of landmarks are labels of lower frequency and familiarity compared to the country names and object names. To test whether these differences could account for the presence of priming following cross-modality presentation, very low frequency names were compared to a set of very high frequency names using the cross-modal

methodology. If frequency and familiarity were responsible for the cross-modality priming found in Experiment 4.1, then it is likely that this could be found when very low and very high frequency words are directly compared. If the findings of Experiment 4.1 occurred due to effects of word frequency, then significant cross-modal facilitation would be expected for the low frequency names, but not for the high frequency names.

The design of the experiment was adapted from Experiment 4.1. Within-modality and cross-modality priming were compared between participants and the effect of priming was a within-participant factor. An additional within-participants factor was introduced, that of word frequency (low, high).

Method

The numbers of critical stimuli were doubled, so that there were 18 critical items in each primed and unprimed set. Half of these items were low frequency names and half were high frequency names. Both sets of names were matched for familiarity, concreteness and word length. The sets of low frequency names had a mean frequency of less than 1 occurrence per million. The sets of high frequency names had a mean frequency of over 500 occurrences per million (Kucera and Francis ratings from the Oxford Psycholinguistic Database. See Appendix 4 for a list of the critical stimuli). The number of filler and unfamiliar items were increased. In the prime phase there were 90 trials. 18 critical items to be primed, plus 27 filler items and 45 unfamiliar items. In the test phase of the experiment there were also 90 trials: 36 critical items (18, primed items, 18 unprimed items) 9 filler items and 45 unfamiliar items.

Participants

Twenty eight participants (6 male and 22 female) took part in the experiment. The age of participants ranged from 18 to 50 years with a mean age of 31 years.

Procedure

The apparatus and procedure was the same as Experiment 4.1. Each phase of the experiment was preceded by ten practice trials. In order to try and equate the processing demands of this experiment with the name familiarity decision to proper names, participants were instructed to make "a familiarity decision to each item" rather than a lexical decision.

Results

As in Experiment 4.1 responses to the critical primed and unprimed items made during the test phase were analysed. A response to an item was only included in the analyses if the correct response was given in both the prime and the test phase. The accuracy and timing of responses is given in Table 4.3. A proportional facilitation score was calculated for each data point (unprimed RT - primed RT/ unprimed RT). The proportional facilitation scores are plotted as a function of noun type and prime task modality in Figure 4.3.

Table 4.3 Mean RT and Response Accuracy (out of 9) for Experiment 4.3

	Primed	Unprimed
Familiarity Decision		
High Frequency words		
Visual - Visual	593 (8.5)	625 (8.8)
Auditory - Visual	598 (8.5)	575 (8.7)
Low Frequency words		
Visual - Visual	615 (8.2)	680 (8.4)
Auditory - Visual	659 (8.8)	667 (9.0)

Figure 4.3 Mean proportional facilitation as a function of name frequency and prime task modality. Error bars indicate a 95% confidence interval.
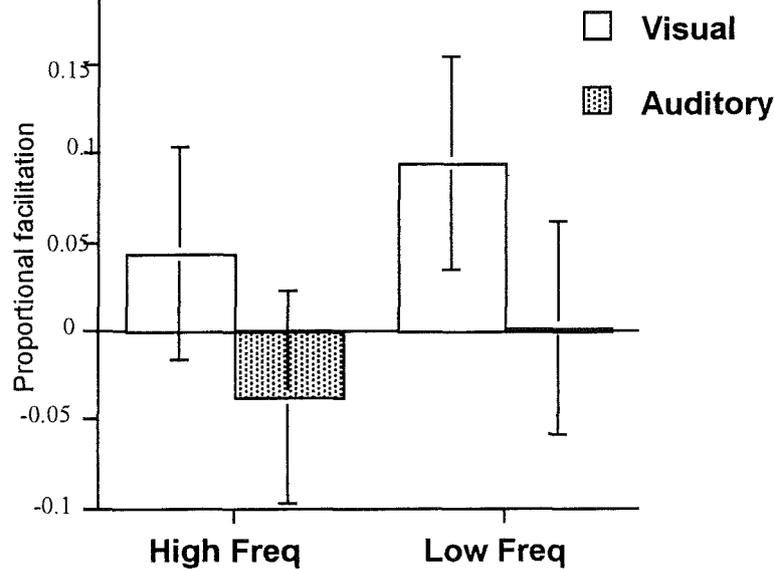
The proportional scores were subjected to an ANOVA taking participants as the random factor with prime task modality as a between-participants factor, and word frequency as a within-participants factor (identified by the suffix 1). A separate ANOVA was carried out taking items as the random factor with prime task modality as a within-items factor and word frequency as a between-items factor (identified with the suffix 2).

The main effect of prime task modality was significant $F_1(1,26) = 5.57$, p < .01; $F_2(1,34) = 5.00$, p <.01. The main effect of frequency was significant in the items analysis $F_1(1,26) = 2.31$, p =.14; $F_2(1,34) = 6.59$, p <.01. The interaction between prime task modality and word frequency was not significant $F_1(1,26) < 1$; $F_2(1,34) < 1$. Simple main effects were used to explore the interaction further. The effect of prime task modality was marginally significant for low frequency words $F_1(1,52) = 3.79$, p = .056; $F_2(1,34) = 3.20$, p = .082 and for high frequency words in the by participants analysis $F_1(1,26) = 2.93$, p = .09; $F_2(1,34) = 1.88$, p = .17.

An analysis of the raw reaction times was also carried out, taking participants as the random factor with prime task modality as a between-participants comparison and the effect of priming and word frequency as a within-participants factor (identified by the suffix 1), and also taking items as the random factor with the effects of word frequency as a between-items factor with priming and prime task modality as within-items factors (identified by the suffix 2).

The interaction between prime task modality and priming was significant $F_1(1,26) = 6.00$, p < .02; $F_2(1,34) = 4.53$, p < .05.The interaction between prime task modality and word frequency approached significance in the by participants analysis and was significant in the by-items analysis $F_1(1,26) = 3.56$, p =.07; $F_2(1,34) = 4.17$, p < .05.

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The interaction between priming and word frequency was not significant by participants, but was significant by-items $F_1(1,26) = 2.27$, p =.14; $F_2(1,34) = 5.25$, p < .02. The three way interaction between prime task modality, priming and word frequency was not significant $F_1(1,26) < 1$; $F_2(1,34) < 1$.

Simple main effects were used to explore these interactions. The effect of priming for high and low frequency words was of particular interest. There was a significant effect of priming for low frequency words following the visually presented prime task $F_1(1,26) = 8.30$, p <.01; $F_2(1,34) = 20.47$, p < .01. There was a significant effect of priming for high frequency words following the visually presented prime task in the items analysis only $F_1(1,26) = 1.89$, p =.18; $F_2(1,34) = 3.93$, p < .05. However, the effect of priming was not significant for the auditory presented prime task for the high or low frequency words (All F's < 1.7, all p's > .19).

Discussion of Experiment 4.3

Experiment 4.3 tested the hypothesis that low frequency words would produce more cross-modal facilitation compared to high frequency words. An advantage for low frequency words was found for the visually presented prime task. However, no cross-modal facilitation occurred for high or low frequency words when presented as a familiarity decision task. Therefore, evidence of word frequency affecting cross-modal presentation was not found. It can therefore be concluded that word frequency was unlikely to be responsible for the cross-modal facilitation found in Experiment 4.1. As a familiarity decision task was used in Experiment 4.3 and similar results to those obtained with a lexical decision task

in Experiment 4.1 were obtained, differences in cross-modality priming due to task demands can be eliminated.

A further consideration is the conceptual specificity of names. A number of authors have suggested that people's names occupy the sub-ordinate level of a conceptual hierarchy whereas object names occupy the base level of a hierarchy (e.g. Tranel, Damasio & Damasio, 1997; Durso & O'Sullivan, 1983). The same argument may be posed for differences between landmark names and country names. Experiment 4.4 aimed to identify whether conceptual specificity could be responsible for the differences in cross-modal facilitation found in Experiment 4.1.

Experiment 4.4

Experiment 4.4 investigated names derived from a conceptual hierarchy. It might be argued that people's names and names of landmarks are sub-ordinate labels whereas country names are more likely to be names belonging to a base level hierarchy. To test whether hierarchical differences could account for differences in cross modal facilitation, highly specific names (dog breeds) were compared to a set of very general (animal) names using the cross modal methodology. If high degrees of specificity are responsible for cross modality priming then significant cross modal facilitation would be expected for the subordinate dog breed names, but not for the general animal breed names.

Method

The design of the experiment was adapted from the previous experiments. As in Experiment 4.1, within modality and cross modality priming were compared between participants and the effect of priming was a within participants factor. As in the previous experiment regarding name frequency, an additional within-participants factor was introduced, that of name (specific-dog breeds, general-animals). The numbers of critical stimuli were doubled, so that there were 18 critical items in each primed and unprimed set. Half of these items were dog breed names and half were animal names (see Appendix 5 for a list of the critical stimuli). The number of filler and unfamiliar items were increased accordingly (half of the items represented general names and half represented specific names). In the prime phase there were 90 trials. 18 critical items to be primed, plus 27 filler items and 45 unfamiliar items. In the test phase of the experiment there were also 90 trials: 36 critical items (18, primed items, 18 unprimed items), 9 filler items and 45 unfamiliar items. Each phase of the experiment was preceded by ten practice trials. Participants made a familiarity decision in both phases of the experiment. Therefore the design and procedure was the same as Experiment 4.3, except the factor of word frequency had been replaced with conceptual specificity.

Participants

Twenty eight participants (6 male and 22 female) took part in the experiment. The age of participants ranged from 18 to 50 years with a mean age of 31 years.

Results

Table 4.4 Mean Reaction Times and Response Accuracy (out of 9) for Experiment 4.4.

	Primed	Unprimed
Familiarity Decision		
Dog breed names		
Visual - Visual	571 (8.1)	691 (8.2)
Auditory - Visual	757 (8.1)	781 (8.5)
Animal names		
Visual - Visual	542 (8.6)	590 (8.8)
Auditory - Visual	662 (8.8)	669 (8.8)

Figure 4.4 Mean proportional facilitation as a function of type of name and prime task modality. Error bars indicate the 95% confidence interval for the effect of prime task modality.
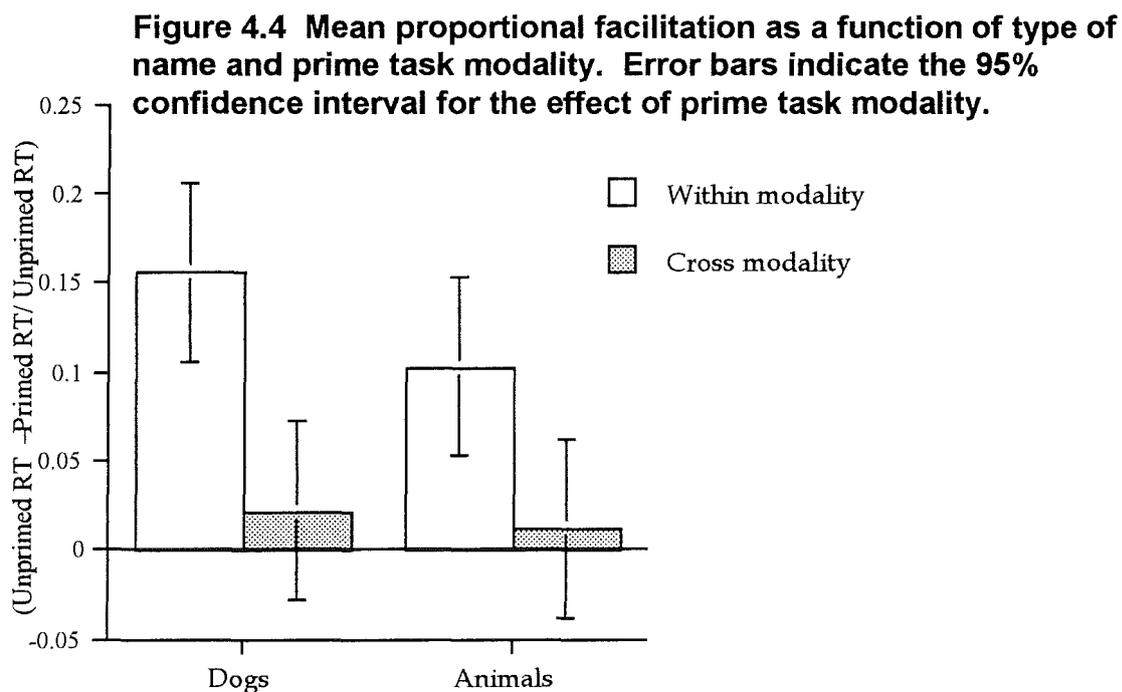
Figure 4.4 illustrates the mean proportional facilitation for animal name and dog breed name stimuli for within and cross modality presentation. A table of mean reaction times and error rates can be found in the table above. As in the previous experiments a proportional score was calculated, and ANOVA was performed by participants and by items. There was a significant main effect of modality $F_1(1,26) = 10.42$, $p < .01$; $F_2(1,34) = 3.95$, $p = .055$ The main effect of name type was not significant $F_1(1,26) < 1$; $F_2(1,34) = 1.84$, $p = .18$. The interaction between modality and stimulus was not significant $F_1(1,26) < 1$; $F_2(1,34) < 1$.

An analysis of the raw reaction time data was also carried out. With ANOVA by participants, taking prime task modality as a between-participants factor with name type and priming as within-participant factors (identified with the suffix 1). An analysis by items was also performed taking prime task modality and priming as within-items comparison and taking name type as a between-items factor (identified with the suffix 2). The comparison pertinent to the experimental hypothesis concerns the interaction term. The interaction between prime task modality and priming was significant in the by-participants analysis $F_1(1,26) = 7.01$, $p < .01$; $F_2(1,34) = 2.86$, $p = .09$. The interaction between prime task modality, name type, and priming was not significant $F_1(1,26) < 1$; $F_2(1,34) = 2.26$, $p = .14$. Simple main effects were used to explore this interaction. The effect of priming was significant for both types of names following the visually presented prime task (dog names $F_1(1,26) = 18.6$, $p < .01$; $F_2(1,34) = 10.87$, $p < .02$; animal names $F_1(1,26) = 4.29$, $p < .04$; $F_2(1,34) < 1$). The effect of priming following the auditorily presented prime task was not significant (Both F_1s < 1; F_2's < 1.5, All p's $> .22$).

Discussion of Experiment 4.4

The results clearly show that neither specific names of dog breeds or general names of animals produce cross modal facilitation. The lack of priming cannot be attributed to a lack of power as the same stimuli produced significant facilitation when the prime phase and the test phase were presented within the same modality. The interpretation of Experiment 4.4 must be that the differences in the cross modal effects produced for the landmark and the country name stimuli, cannot be attributed to an effect of conceptual specificity.

Furthermore, the results indicate that conceptual specificity does not produce the differences in facilitation found with the landmark names and country names. This finding refutes Durso and O'Sullivan's notion of conceptual specificity of people's names. In spite of changes to conceptual specificity, names taken from different levels of a conceptual hierarchy do not produce differences in cross-modal priming. The data also indicate that the idea that the characteristics of proper name processing occur due them being highly specific concrete entities (Damasio et al. 1995) is unlikely. The dog breed names are highly specific and refer to concrete entities. These data also confirm that common names do not produce facilitation following cross modality presentation.

Experiment 4.5

Some authors have noted that some proper names (such as city names and country names) can be used as adjectives as well as proper names. This flexibility of use has been identified as a possible reason why there might be a

category specific sparing in proper name anomia. The next hypothesis to explore was that of "adjectivisation" which can be translated directly into experimental study. Brédart (1999, personal communication) has conducted two experimental studies of concerning adjectivisation. The first experiment showed that people were more prone to tip-of-the-tongue states when naming people with non-adjectivizable names than when naming people with adjectivizable names. The adjectivized and non-adjectivized names were matched with respect to a number of factors such as person familiarity, AOA, number of phonemes etc. However, Brédart indicates that frequency of use is difficult to control for with this kind of stimulus set. Brédart has also acknowledged that for adjectivized names, one should take into account the frequency of use of the name itself but also of the derived adjective. The frequency of use of the derived adjective is presumably zero for non-adjectivised names, but not for adjectivised names. It is possible that the Tip-of-the-Tongue phenomena that were found may have occurred due to adjectivisation itself or to a difference in the frequency of use. Brédart conducted an additional experiment with the people's names presented in the cross-modality priming paradigm. The two manipulated factors were the modality of presentation and the kind of names (adjectivised vs. non-adjectivised). Cross-modality priming was found in the name recognition task, but the effect occurred for both types of names (both the adjectivised names and the non-adjectivised names). In summary, evidence to support the notion that adjectivisation and flexible use are the reasons why there is no cross-modal facilitation. A more pertinent explanation may be found when one considers the nature of identity. Unlike proper names that label an individual identity, words (such as country names) that could be used as adjectives would not necessarily require

processing via the token marker. Words that can be used as adjectives as well as proper names, would require much more general links between the semantic system and the lemma cross modal facilitation would not be expected for these stimuli.

A direct comparison was not possible for country names, as all country names could be used as adjectives. Making a direct comparison between country names and a different category of proper name would lead to confounding. Therefore the most suitable stimuli for this investigation were city names. Many city names are readily known and used as adjectives (e.g. Venice– Venetian,Canton-Cantonese). In contrast, there are some city names that do not readily form adjectives (Vancouver, Amsterdam).

Method

The design and procedure was the same as Experiment 4.4, except that the animal and dog name stimuli were replaced with city names. One set of country names also had a commonly known adjectival form, and the other set were not well known as adjectives. See Appendix 6 for a list of the experimental stimuli.

Participants

Twenty eight participants (3 male and 25 female) took part in the experiment. The age of participants ranged from 18 to 50 years with a mean age of 32 years.

Results

As in the previous experiments a proportional score was calculated, and ANOVA was performed by participants and by items. Figure 4.5 illustrates the mean

proportional facilitation for city names in both the within and cross modality

presentation. Mean reaction times and error rates can be found in Table 4.5.

Figure 4.5 Mean proportional facilitation for city names as a function of adjectivisation and prime task modality. Error bars indicate the 95% confidence interval for the effect of prime task modality.
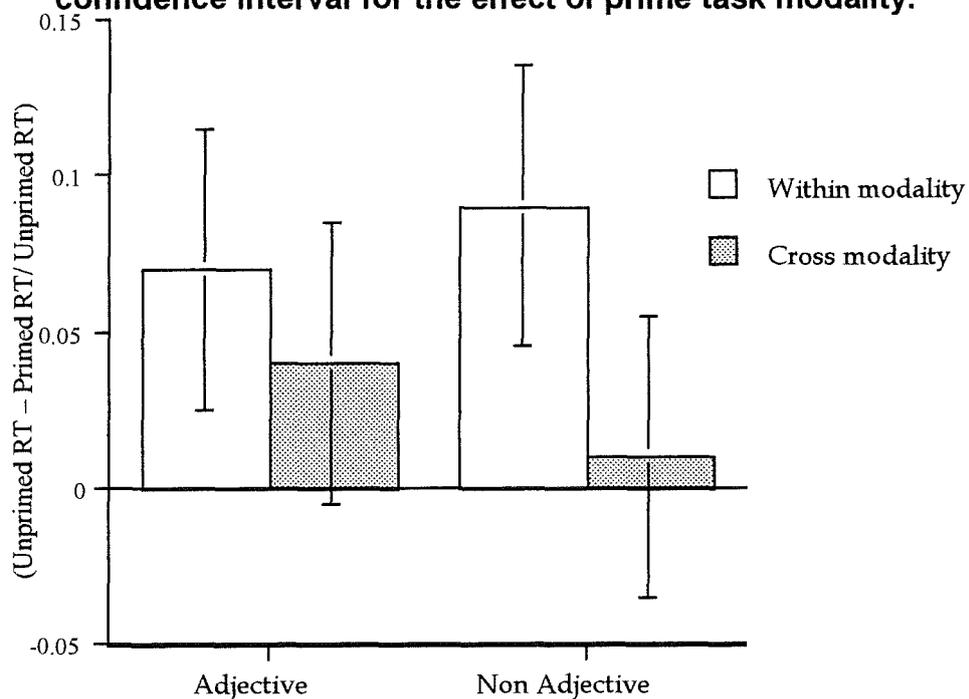
Table 4.4 Mean RT and Response Accuracy (out of 9) for Experiment 4.4

	Primed	Unprimed
Familiarity Decision		
City - Adjective names		
Visual - Visual	554 (8.1)	613 (7.7)
Auditory - Visual	675 (7.9)	688 (7.8)
City Non-adjective names		
Visual - Visual	554 (7.6)	605 (7.6)
Auditory - Visual	637 (8.2)	665 (7.8)

There was a significant main effect of modality $F_1(1,26) = 4.75$, p< .05; $F_2(1,34) = 20.78$, p < .01 indicating that within-modality presentation produced greater priming. The effect of stimulus type was not significant $F_1(1,26) < 1$; $F_2(1,34) < 1$. This indicated that there were no differences in processing for the two stimuli types. The interaction between modality and stimulus was not significant $F_1(1,26) < 1$; $F_2(1,34) < 1$.

An analysis of the raw reaction times was also carried out. The interaction between modality and priming was significant $F_1(1,26) = 4.2$, p < .05; $F2(1,34) = 15.63$, p < .01. Interactions involving the factor of stimulus type were not significant (All F's > 2.6, All p's <.1). Simple main effects were used to explore the interactions. The effect of priming following the auditorily presented prime task is of particular interest in the current experiment. No significant priming occurred following the auditory prime task for any type of city names

(Adjectivisable: $F(1,26) < 1$; $F(1,34) < 1$; Non Adjectivisable: $F(1,26) = 2.86$, $p < .1$; $F(1,26) < 1$).

Discussion of Experiment 4.5

The present experiment found no reliable cross modal priming for city names, and there were no differences in facilitation between city names that could form well known adjectives compared to those known only in their proper name form.

General Discussion of Cross-modal Experiments

Experiments 4.1 – 4.5 were all concerned with cross modal facilitation. Experiment 4.1 found cross-modal facilitation for people's names and landmark names but not for country names. Cross-modal facilitation was not found when object names were presented for lexical decision. All three types of proper names that were tested are unique – and portray a single entity. This suggests that the notion of proper names processing being attributed solely to uniqueness is not adequate. The differences in processing cannot be accounted for in terms of meaninglessness, as landmark names often contain information about the nature of the place (for example Tower Bridge is a bridge etc.). In this case cross-modal facilitation would not be expected for the landmark stimuli. Therefore meaningfulness alone cannot account for these data. Experiment 4.2 indicated that the differences in cross-modal facilitation for landmark names and country names were robust. Experiment 4.3 found no evidence that the presence of cross-modal facilitation could be attributed to name frequency.

Experiment 4.4 identified that the differences in cross-modal facilitation could not be attributed simply to the hierarchical structure of a conceptual category. Neither general names or highly specific animal names produced cross-modal facilitation. Finally, Experiment 4.5 investigated whether the lack of cross-modal facilitation found for country names, could be related to their ability to be used as adjectives. Two different classes of city names were compared using the cross-modal presentation. No differences were found between city names that were known as both proper names and adjectives, compared to a set known only as proper names. No cross-modal facilitation was found for any of the city names. Data therefore indicated that the way in which names can be used was unlikely to account for the lack of priming found for the country name stimuli. However, an interesting follow on to these cross-modal experiments would be to present country names in their adjectivised form (e.g. Italian, Mancunian etc). In line with the data from Experiment 4.5 no cross-modal priming would be expected, as a name familiarity decision to such items would be taken at the level of the lemma, and would not require access to the token marker.

The data contained in this chapter indicate that not all proper names produce consistent processing. The data may indicate that it is not proper names per se, but pure referencing expressions that require processing via a token marker in memory. However one must consider how to form a test of whether an item is truly a pure referencing expression.

Chapter 5

Facilitation following Name Production

The experiments in the previous chapter indicated that there may be differences in the processing characteristics of different categories of proper name. If there are indeed differences in the representation of different categories of proper noun, these differences should also be apparent in other paradigms. Valentine, Hollis and Moore (1998) provided evidence that producing someone's name in response to seeing their face facilitated a subsequent name familiarity decision to the same person's written name. As a familiar face is encountered, the appropriate token recognition unit that codes for the visual image would become active (see Figure 1). In turn, the corresponding token marker would become active and pass activation onto the appropriate lemma. Following lemma selection, the phonology of the name would be retrieved and passed for articulation. A subsequent name familiarity decision task requires activation to pass between the lemma and the identity information represented at the token marker. As both of these tasks require processing between the token marker and lemma, it is predicted that naming the face of a celebrity would produce an effect of repetition on a subsequent name familiarity decision to the same person's name.

Facilitation is not produced if the prime task involved a face familiarity decision, rather than name production. A familiarity decision to a face does not require the lemma to become activated. Therefore, a face familiarity decision is not expected

to prime a subsequent name familiarity decision. In this case the prime task only requires processing between the token recognition unit and the token marker, whereas the task during the test phase requires processing between the token marker and the lemma.

Similarly, if the test phase task required name production task rather than a name familiarity decision, the locus of priming would be placed at the lexeme. Consequently, a different set of predictions emerge when the test phase requires name production, rather than the name familiarity decision task. Studies that are based on these predictions were reported in Chapter 3.

Valentine et al. (1998) did not report any new evidence on facilitation from picture naming as a prime task for common nouns. Evidence reveals mixed findings regarding repetition following name production. Production of an everyday object name does not prime a subsequent lexical decision to the same item's name (e.g. Morton, 1979; Winnick & Daniel, 1970; Scarborough, Gerard & Cortese, 1979). In contrast, name production has been found to benefit explicit recognition of the same item's name (e.g. Park et al., 1998).

Similar processing for all proper names could be expected if all the sub-categories of proper name are considered to have a similar cognitive architecture. Variations in the processing of sub-categories of proper name may indicate that differences in their representation exist. It may also provide a basis for choosing between theories of uniqueness, meaninglessness, and pure reference.

Experiment 5.1

Experiment 5.1 aimed to replicate the original findings of Valentine et al. (1998) using people's faces and names as stimuli. In addition the study was extended to investigate the facilitation produced when other categories of proper names served as stimuli (pictures and names of famous people and landmarks, images of maps and names of countries). The experiment also included pictures of objects and their names as stimuli. In line with the original hypothesis, it was predicted that a face naming task would prime a subsequent name familiarity decision when people's names were used as stimuli. The facilitation occurs as both face naming and name familiarity decision to people's names are tasks that require processing between the token marker and the lemma. Thus, any facilitation produced following the name production prime task would be comparable to that observed when the same item was repeated for a name familiarity decision during the prime and test phase. In contrast, the face familiarity decision does not require processing between the token marker and the lemma, and therefore no priming is expected.

Object picture naming followed by lexical decision does not involve processing via a token marker. Although picture naming involves processing via the conceptual system, it operates via diffuse links, and not via a token marker. A lexical decision to a common name can be made on the basis of activation of the lemma alone, and does not require access to the conceptual system. Therefore no comparable facilitation was expected when an object naming task was followed with a lexical decision task to the same items name.

Given the findings of the cross-modality experiments reported in Chapter 4, the processing characteristics of country names are uncertain. If the lack of cross-modality priming in Chapter 4 occurred due to differences in cognitive architecture, then it is follows that analogous findings would be apparent in the name production experiments; the production of a country name would not prime a familiarity decision to a visually presented country name.

Method

Participants

Two hundred and forty people (54 male and 186 female) participated in the experiment. The age of the participants ranged between 19 and 45 years with an average of 21 years.

Stimuli / Apparatus

Two sets of 9 critical items were formed for each noun category, as for Experiment 4.1 (see Appendix 3). The pictorial stimuli were formed by selecting a black and white digitised image for each item. The image was 6cm by 6cm in the centre of the visual display. An additional selection of 41 images (for each noun category) were selected as familiar filler items for the picture naming task. A further selection of 25 unfamiliar images for the picture familiarity prime task were also found as stimuli in the picture familiarity decision task. For the category of people, images were simply faces of celebrities and unknown people. For the category of landmarks, images were of famous and unfamiliar buildings, monuments etc. Equal proportions of buildings, bridges, monuments,

natural landmarks were assigned to serve as critical, filler and unfamiliar items. For the category of countries a selection of blank map outlines were employed as stimuli (names of cities, towns etc. were removed). On each map, an arrow indicated which country was "to be named". Maps were made "unfamiliar" for use in the picture familiarity decision, by distorting coastline and positioning the arrow so that the countries in question were no longer recognisable. For the everyday object stimuli a series of line drawing were selected. The unfamiliar picture items were non-objects, taken from a study by Kroll and Potter (1984). For the test phase, a selection of filler and unfamiliar names were formed as in Experiment 4.1.

Design

The experiment had a mixed design with three factors: noun category (people, landmarks, countries, objects) and prime task (picture naming, picture familiarity decision and name familiarity decision or lexical decision) were between-participants factors. Priming (primed vs. unprimed) was a within- participants factor.

For each noun category, there were two sets of 9 critical items. One of these sets appeared in both the prime phase and the test phase. Responses to these items formed the data for the primed items. The other set of 9 critical items appeared only in the test phase. Responses to these items formed the data for the unprimed items. With the exception of the primed items, no other items were repeated between prime and test . The assignment of items to the primed and unprimed conditions was counterbalanced across participants for each combination of prime phase task.

The experiment consisted of two phases, a prime phase and a test phase.

For the prime phase, participants who received proper name stimuli, carried out either a picture familiarity decision, a picture naming task, or a name familiarity task. Participants who received the object names performed a picture familiarity decision, a picture naming task or a lexical decision. The prime phase for the picture naming conditions consisted of a total of 50 images (9 primed critical items and the remaining items as familiar filler items). The prime phase for the picture familiarity decision consisted of 9 images of the critical items (primed) 16 filler (familiar) items and 25 unfamiliar items. The prime phase for the name familiarity and lexical decision consisted of the name of each item presented in upper case 14 point, Arial font in the centre of the computer screen. In keeping with the other two prime tasks the presentation consisted of 50 items: 9 critical items (primed) 16 filler familiar names and 25 unfamiliar names.

The test phase was presented visually to all participants as a name familiarity decision for the proper name groups and as a lexical decision for the object name group. The test phase took the same format for all of the noun groups. The written names were presented in upper case 14 point, Arial font on a PC screen as in Experiment 4.1. The participants' responses were recorded using key presses on the keyboard. The experiment was programmed using Micro-Experimental Laboratory (MEL2). Reaction times were recorded with millisecond accuracy.

Procedure

Participants were allocated to one of the noun categories and took part in a prime phase followed by a test phase. Each phase was preceded by ten practice trials.

During the prime phase participants either carried out the picture naming task, the picture familiarity task, or the name familiarity task (lexical decision in the case of the object stimuli). All stimuli were presented on the computer screen in a random order. In the picture naming condition, participants were asked to articulate the name of the item, as quickly as possible. If the participant was found to be in a tip-of-the-tongue state, the first phoneme was given as a prompt. Once the participant had given their vocal response, the experimenter recorded the accuracy of the response by key press. For the picture familiarity decision, participants saw the series of stimuli, and were asked to make a familiarity decision to each item by key press as quickly as possible. In the name familiarity decision, participants were shown the selection of famous and unfamiliar names and asked make a familiarity decision by key press as quickly as possible. The group of participants who received the object stimuli, were asked to make a lexical decision by key press as quickly and accurately as possible.

The prime phase was followed by the test phase which involved a name familiarity decision (or lexical decision) presented on computer. As in the previous experiments, participants were not informed of this additional task. Each of the experimental trials consisted of a 250msec tone followed after 500msec by presentation of the stimulus. In each trial, a name was presented and participants were instructed to make a familiarity decision (or lexical decision) by pressing 'yes' or 'no' using the keys provided. Participants were instructed to respond as quickly and as accurately as possible. The participants response terminated the display of the stimulus.

Results

Responses to the nine critical primed and unprimed items made during the test phase were subjected to analysis. A response to an item was only included in the analyses if the correct response was given in both the prime and the test phase. The minimum number of critical primed items contributing to each cell of the analysis was 5. The mean RT and accuracy of responses to the critical items are given in Table 5.1. A proportional facilitation score was calculated for each data point (unprimed RT - primed RT / unprimed RT). The proportional facilitation scores are plotted as a function of noun type and prime task modality in Figure 5.1.

Figure 5.1 Mean proportional facilitation as a function of prime task and noun type. Error bars indicate the 95% confidence interval for the effect of prime task modality.

☐ Name Familiarity

▦ Naming

■ Picture Familiarity
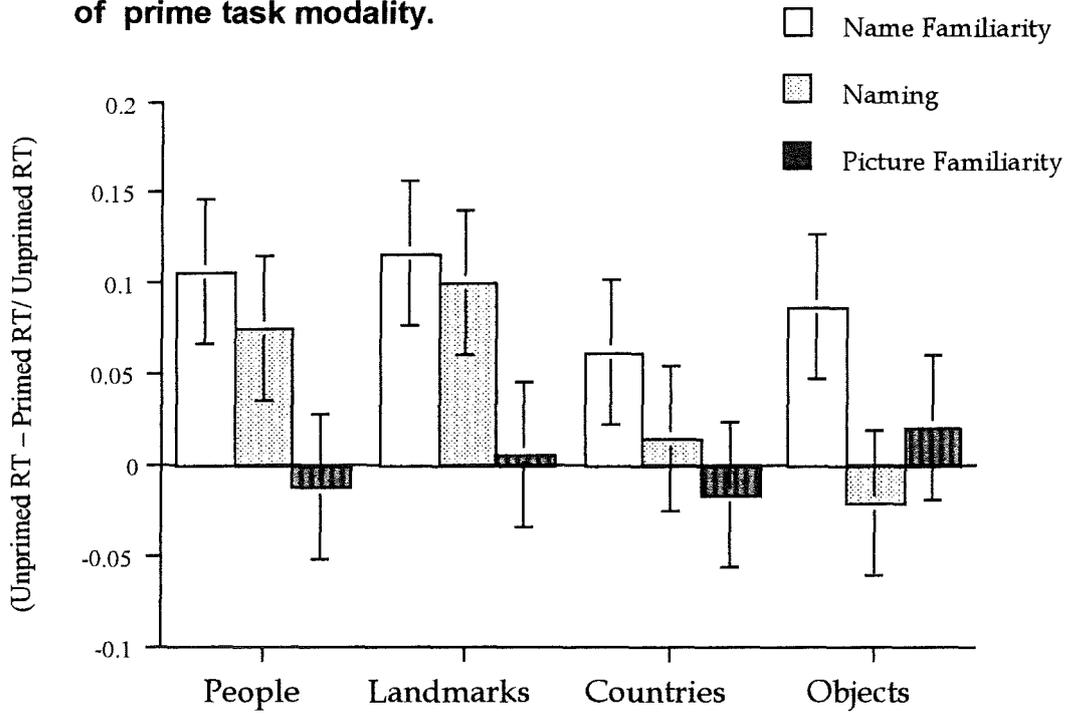
Table 5.1 Mean RT and Response accuracy (out of 9) for Experiment 5.1.

	Primed		Unprimed	
Familiarity Decision				
People's names				
Face Familiarity	714	(8.4)	715	(8.2)
Face Naming	679	(8.5)	744	(8.2)
Name Familiarity	617	(7.9)	692	(7.7)
Landmark names				
Picture Familiarity	707	(8.1)	716	(7.5)
Picture Naming	830	(8.2)	940	(7.9)
Name Familiarity	689	(8.4)	798	(7.8)
Country names				
Picture Familiarity	543	(7.1)	537	(8.4)
Picture Naming	527	(8.0)	536	(8.9)
Name Familiarity	498	(8.1)	539	(8.4)
Lexical Decision - Object Names				
Picture Familiarity	567	(8.3)	588	(8.2)
Picture Naming	609	(8.6)	608	(8.8)
Lexical Decision	519	(8.2)	573	(8.8)

The proportional scores were subjected to ANOVA taking participants as the random factor with prime task and noun category as a between-participants factor (identified by the suffix 1). A separate ANOVA was carried out taking items as the random factor with prime task as a within-items factor and noun category as a between-items factor (identified with the suffix 2). The main effect of noun category was significant for participants only $F_1(3,228) = 3.37$, $p < .01$; $F_2(3,68) < 1$. The main effect of prime task was significant $F_1(2,228) = 12.43$, $p < .01$; $F_2(2,136) = 8.37$, $p < .01$. The interaction between prime task and noun category was marginally significant $F_1(6,228) = 1.97$, $p = .07$; $F_2(6,136) = 1.93$, $p = .07$.

As the test of the experimental hypothesis concerned particular aspects of the interaction, simple main effects were used to determine whether the effect of prime task differed for the categories of noun. The effect of prime task was significant for the category of people's names in the by-participants analysis and marginally significant in the by-items analysis $F_1(2,228) = 5.92$, $p < .01$; $F_2(2,136) = 2.80$, $p = .06$. The effect of prime task for landmark names was significant $F_1(2,228) = 5.56$, $p < .01$; $F_2(2,136) = 3.43$, $p < .05$. The effect of prime task was not significant for country names analysis $F_1(2,228) = 2.40$, $p = .09$; $F_2(2,136) < 1$. The effect of prime task for object names was significant only in the participant analysis $F_1(2,228) = 4.69$, $p < .01$; $F_2(2,136) < 1$.

A further comparison was carried out which included data only from the picture naming and picture familiarity prime tasks. The interaction between prime task

and priming was significant $F_1(3,152) = 2.82$, p < .05; $F_2(3,68) = 3.23$, p < .05. Simple main effects indicated that the interaction between prime task and priming was significant for the people's name stimuli $F_1(1,152) = 6.64$, p < .01; $F_2(1,68) = 3.79$ p < .05. and landmark names $F_1(1,152) = 4.17$, p < .05; $F_2(1,68) = 9.31$ p < .01. The interaction was not significant for country names $F_1(1,152) < 1$; $F_2(1,68) < 1$, or object names $F_1(1,152) = 1.46$, p = .22; $F_2(1,68) = 1.13$, p = .29.

An analysis of the raw reaction times was also carried out. For brevity, data for the name production prime task was analysed taking participants as the random factor with noun category as a between- participants comparison and the effect of priming as a within-participants factor (identified by the suffix 1). An analysis was also carried out taking items as the random factor with noun category as a between-items comparison and the effect of priming as a within-items factor (identified by the suffix 2). The interaction between noun category and priming was significant $F_1(3,76) = 4.65$, p <.01; $F_2(3,68) = 4.80$, p < .01. Simple main effects were used to explore the interaction. There was a significant effect of priming for people's names $F_1(1,76) = 6.72$, p <.01; $F_2(1,68) = 9.73$, p < .01 and landmark names $F_1(1,76) = 21.33$, p <.01; $F_2(1,68) = 22.47$, p < .01. However, the effect of priming was not significant for country names or object names (All F's < 1).

The patterns of facilitation produced following the face naming prime task and the landmark naming prime task were similar. When country name stimuli were produced, no priming occurred and processing was similar to that observed when the naming of object pictures was followed by a lexical decision.

Discussion of Experiment 5.1

Experiment 5.1 has shown that naming a famous face or landmark facilitates a subsequent familiarity decision to that same item's name. In contrast, producing a country name did not provide similar facilitation. Furthermore, naming a picture of an everyday object did not facilitate a lexical decision to the same item's name. These findings are consistent with those found with the cross-modality presentations reported in Chapter 4. Once again there were differences in the unprimed baseline for the different categories of noun. As discussed previously, these differences can be derived from the model but may also be attributable to differences in word length across the various noun categories. In view of the results of Experiments regarding word frequency (Chapter 4) it is unlikely that the pattern of facilitation observed could be accounted for by word frequency when there are changes in the presentation domain between prime and test.

Although recent research has produced evidence to suggest that facilitation can cross-domain between words and pictures for common names, support for this has not been found in the present data. Park et al. (1998) used a recognition task (have you seen this item previously? yes/no) following a naming task and a word stem completion task. In contrast the experiments reported here employed a name familiarity decision (is this a name of a familiar item? yes/no). The recognition task requires explicit recall whereas the name familiarity decision is a test of implicit memory. These data support the view based on earlier research that naming a picture of a common object does not facilitate subsequent

recognition (lexical decision) of the same items name (e.g. Morton, 1979; Winnick & Daniel, 1970; Scarborough et al. 1979).

In both Experiments 4.1 and 5.1, country names show processing characteristics that are more akin to common names than with the other proper name stimuli that have been used in these experiments. This finding can be explained by the model proposed by Valentine et al. (1996) if it is assumed that country names have a diffuse connectivity between the lemma and the conceptual system. If this is the case, the lemma rather than the token marker is the node that first allows access to the conceptual system. Therefore, under the processing assumptions made, a familiarity decision to a country name can be based on the activity of its lemma. Consequently, no priming following name production is found for country name stimuli presented in a name familiarity decision task, as there are no processing pathways in common to the prime and test task

It might be argued that the images of maps and landmarks were not as memorable as the landmark pictures in terms of visual familiarity or complexity. These facets of the visual image may have made the landmark stimuli prone to an episodic influence compared to the country name stimuli (although note that the images were not presented during the test task). In order to determine whether such a factor could account for the differences in the processing of landmark and country names an additional experiment was performed. Experiment 5.2 required participants to produce landmark or country names from the same pictorial stimulus. If differences in facilitation from production of the landmarks and country names were still apparent, these data would provide

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further support for the idea that processing of names of landmarks and countries do indeed differ in their underlying cognitive architecture.

Experiment 5.2

The aim of Experiment 5.2 was to replicate the findings of Experiment 5.1 for country names and landmark names. The experimental design was adapted so that the participants produced either a country name or a landmark name to the same picture. This would identify whether the differences between the images used in Experiment 5.1 were responsible for the pattern of facilitation observed for country and landmark names. The requirement for participants to be able to produce both types of response reduced the number of suitable items that were available. Therefore an intervening task was performed between the prime phase and the test phase in an attempt to reduce the possibility of episodic mediation of any facilitation attributable to repetition. In light of the results of Experiment 5.1, it was predicted that a landmark naming task would prime a subsequent name familiarity decision when landmark names were used as stimuli. The facilitation would occur as both the landmark naming and name familiarity decision tasks require processing via the token marker-lemma link. In contrast, familiarity decision to a country is now assumed only to require processing as far as the lemma. Therefore no comparable facilitation was expected following the production of country names. Differences in facilitation for the landmark and country names would provide further support for the idea that the processing of landmark and country names differ in their underlying cognitive architecture.

Method

Participants

Twenty eight participants were tested. Data from four participants were discarded as these participants were unable to perform the naming prime task successfully. Data from 24 (5 male and 19 female) people contributed to the analysis. The age of these participants ranged between 19 and 48 years with an average of 32 years.

Stimuli / Apparatus

Two sets of 9 critical items were formed, by selecting a black and white digitised image of a famous landmark from different countries around the world (for example - the Eiffel Tower - France, Buckingham Palace - England, Statue of Liberty - United States). Each item was selected from a different country so that no two stimuli (critical or filler item) depicted places from the same country (See Appendix 7). In addition to the critical items, a selection of 6 images of the same dimensions were selected as familiar filler items for naming. The dimensions of the images were the same as in Experiment 5.1.

A selection of 50 unfamiliar images were chosen for the intervening task. Half of these images depicted natural landscapes (such as mountains, forests and seascapes) and the other half depicted 'man-made' structures (statues buildings and bridges). None of the unfamiliar pictures was identifiable, neither could they be attributed to any particular country. A further ten picture items were used for practice.

For the test phase, a selection of filler familiar and unfamiliar country and landmark names were formed as in Experiment 5.1. Eighteen stimuli corresponded to the two sets of critical items, together with 7 filler familiar items not presented in any other part of the experiment. Twenty five unfamiliar items were formed as in Experiment 5.1. A further ten names were used for practice.

Design

The experiment had a mixed design with two factors: prime task (landmark naming, country naming) was a between-participants factors. The effect of priming (primed, unprimed) was a within-participants factor.

For each prime task, there were two sets of 9 critical items. One of these sets appeared in both the prime phase and the test phase. Responses to these items formed the data for the primed items. The other set of 9 critical items appeared only in the test phase. Responses to these items formed the data for the unprimed items. With the exception of the primed items, no other items were repeated between prime and test. The assignment of items to the primed and unprimed conditions was counterbalanced across participants for each combination of prime phase task.

The experiment consisted of three phases, a prime phase, an intervening task and a test phase. For the prime phase, participants received either the landmark naming task or the country naming task. In each case the prime

consisted of a total of 15 images (9 primed critical items and the remaining items as famous filler items).

Following the naming trials, all participants received the series of unfamiliar items and were asked to perform a man-made/natural decision by key press as quickly as possible.

The test phase was presented visually to all participants as a name familiarity decision. Participants who produced landmark names, received landmark names during the test phase, and vice-versa. The written names were presented in upper case 14 point, Arial font on the PC screen as in Experiment 5.1. The participants' responses were recorded using key presses on the keyboard. The experiment was programmed using Micro-Experimental Laboratory (MEL2). Reaction times were recorded with millisecond accuracy.

Procedure

Participants were allocated to either the landmark name or the country name group and took part in a prime phase followed by the intervening task and the test phase. In the landmark naming condition, participants were asked to articulate the specific name of the landmark, as quickly as possible. If the participant was found to be in a tip-of-the-tongue state, the first phoneme was given as a prompt. Once the participant had given their vocal response, the experimenter recorded the accuracy of the response by key press. The country naming condition was conducted in the same way, however, participants were asked to produce the name of the country where the place could be found.

The prime phase was followed by the intervening task. All participants received the series of unfamiliar items and were asked to perform a "man-made"/"natural" decision by key press as quickly as possible. The 50 items appeared in random order.

Finally the test phase was presented which involved a name familiarity decision. The timing and procedure for the prime and test phase was the same as in Experiment 5.1 except that participants who produced landmark names performed the familiarity decision with landmark names and conversely participants who had produced country names performed the familiarity decision with the country name stimuli. Once again participants were not informed given prior warning of this additional task. The test phase was preceded by ten practice trials. All stimuli were presented on the computer screen in a random order.

Results

Responses to the nine critical primed and unprimed items made during the test phase were subjected to analysis. A response to an item was only included in the analyses if the correct response was given in both the prime and the test phase. The mean RT and accuracy of responses to the target items are given in the Table 5.2.

As before a proportional facilitation score was calculated for each data point (unprimed RT - primed RT/unprimed RT). The mean proportional facilitation is plotted as a function of noun category in Figure 5.2.

Figure 5.2   Mean proportional facilitation as a function of prime task. Error bars indicate the 95% confidence interval for the effect of prime task.
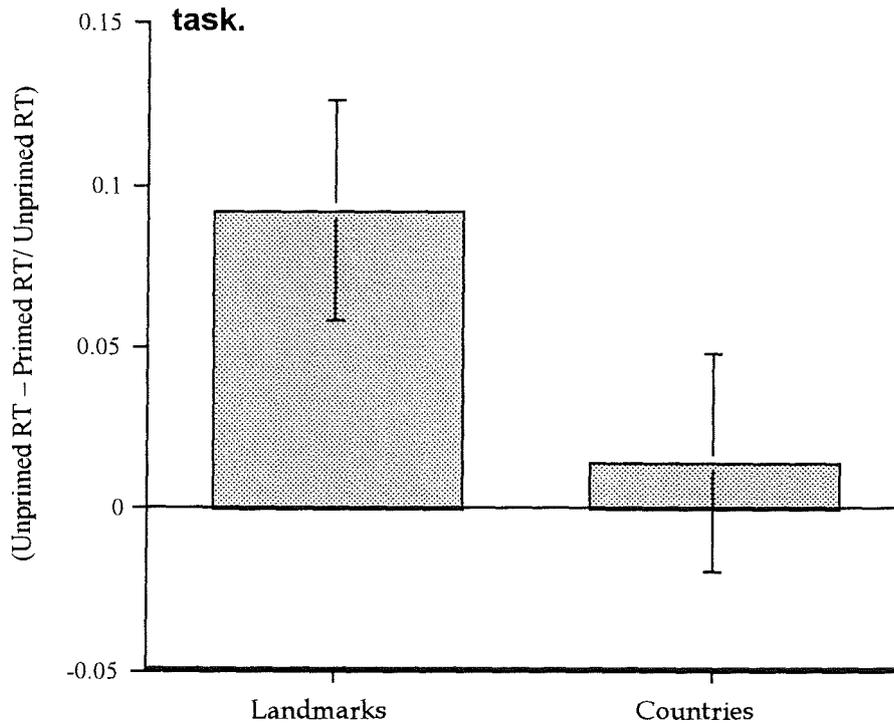
Table 5.2 Mean RT and Response Accuracy (out of 9) for Experiment 5.2.

	Primed	Unprimed
Landmark names	727 (6.8)	805 (6.7)
Country names	556 (7.8)	565 (8.0)

The proportional scores were subjected to ANOVA taking participants as the random factor with prime task as a between participants factor (identified by the suffix 1). A separate ANOVA was carried out taking items as the random factor with prime task as a between items factor (identified with the suffix 2). The main effect of prime task was significant $F_1(1,22)$ = 7.67, p < .01; $F_2(1,34)$ = 4.43, p <.05. indicating that the proportional facilitation that followed the production of country names was significantly different from that found after the production of landmark names.   The 95% confidence interval in Figure 5.2 indicates that

facilitation following name production occurred only when landmark names were produced.

An analysis of the raw reaction times was also carried out, taking participants as the random factor with noun category as a between-participants comparison and the effect of priming as a within-participants factor (identified by the suffix 1), and also taking items as the random factor (identified by the suffix 2). The interaction between noun category and priming was significant $F_1(1,22) = 9.77$, p <.01; $F_2(1,34) = 5.50$, p < .02. Simple main effects were used to explore the interaction. There was a significant effect of priming for landmark names $F_1(1,22) = 24.79$, p <.01; $F_2(1,34) = 10.90$, p < .01. However, the effect of priming was not significant for country names (Both F's < 1).

Discussion of Experiment 5.2

The results clearly indicate that producing the name of a landmark facilitates the subsequent familiarity decision to the same item's name. This finding contrasts with producing country names, where no comparable facilitation was found. In this experiment the verbal responses made during the prime phase were produced in response to seeing the same picture. Thus, it is unlikely that differences in the quality of the pictorial images (for the landmark and country stimuli) that were used in Experiment 5.1 were responsible for the lack of facilitation observed for country names in that experiment. Similarly, the findings of the current experiment cannot be attributed to one class of image being more memorable than the other. The vocal responses were made to the same stimuli with noun category manipulated as a within-participant factor. Therefore

differences in performance between groups of participants cannot account for the differences in priming observed.

The intervening task was used to minimise the influence of episodic retrieval, making episodic explanations untenable. The results of this experiment therefore support the interpretations made in Chapter 4 and following Experiment 5.1.

General Discussion of Experiments 5.1 and 5.2

Experiment 5.1 found that producing the name of a person or a landmark facilitated a subsequent name familiarity decision to the same item's name. These findings contrasted with those found when the same tasks were presented with country name stimuli. Country names did not produce priming following name production. Production of a common name (object name) did not prime a subsequent lexical decision to the same item's name. Experiment 5.2 replicated the findings for the landmark and country names, and indicated that the lack of priming found for the country name stimuli could not be attributed to differences in the images used for naming in the prime phase of Experiment 5.1.

What implications do these data have for theories of proper name processing? These findings are difficult to reconcile with an explanation of uniqueness, as peoples, names, landmark names and country names are all unique (for example, there is only one Bill Clinton, one Statue of Liberty and one United States of America. In spite of their uniqueness these stimuli produce different cognitive phenomena.

Another theory regarding proper names is that that they differ from common names with respect of meaningfulness. However, landmark names often contain a greater degree of meaning compared with people's names and country names which can be considered arbitrary. For example, The Eiffel Tower is a tower and Tower Bridge is a bridge, next to the Tower of London). In spite of varying degrees of meaninglessness, landmark names and people's names produce similar cognitive phenomena.

However, if the key to proper name processing is the fact that they are pure referencing expressions, then one would expect that only sub-categories of proper name that have pure reference would produce phenomena that we usually associate with proper names. Both landmark names and people's names can be deemed to be pure referencing expressions, whereas country names can be used in a variety of different ways, act as adjectives and can be considered far more like concepts than the other classes of proper names that have been considered. So what appears to differ between the categories of proper name, is the nature of identity - the part of meaning that psycho-linguists term "sense" rather than simply "meaningfulness".

The names of people and landmarks are both pure referencing expressions; they also produce similar priming phenomena. The data suggest that it is pure reference that may be captured in a model such as that proposed by Valentine *et al.* (1996). According to this premise, country names do not appear to produce cross-domain facilitation as their linkages are diffuse and indirect, due to their

conceptual nature. Accordingly, due to the generality of their links between the conceptual system and the lemma, access would not require mediation via a token marker. The data therefore comply with the model proposed by Valentine, Brennen and Brédart (1996) extending the role of the token marker to some classes of proper name other than people's names (i.e. landmarks). The data also demonstrate that the role of a token marker is not universal for all categories of proper name (i.e. not country names).

Chapter 6

Picture-word Interference and Lexicalisation

One issue that has consequences for the model by Valentine et al. is the nature of organisation within the semantic lexicon. Is the lexicon categorically organised, and if so to what extent? In the diagrammatic model of the cognitive architecture proposed by Valentine and colleagues, the semantic lexicon (lemma) is portrayed with categorical organisation; one part of the lemma is involved with the representation of people's names, whereas another part of the lexicon is involved with the representation of common names (note the dotted line which represents the division in Figure 6.1 below).
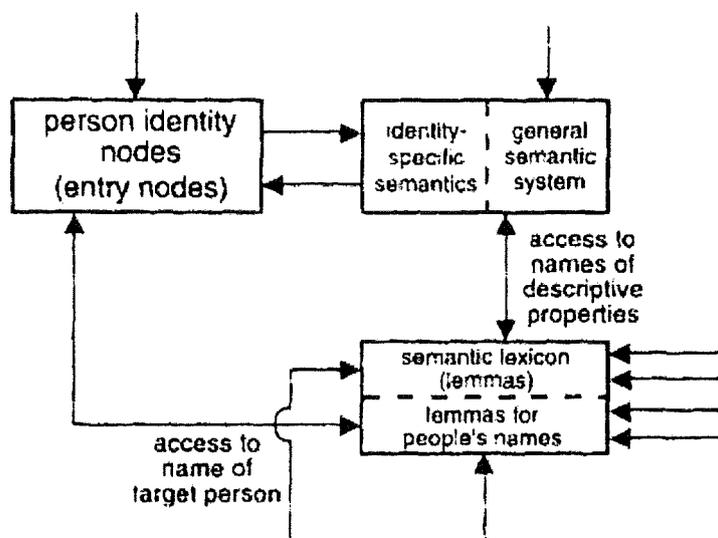
Figure 6.1. The Organisation of the Lexicon (lemmas). The dotted line reflects the categorical organisation.

This organisation may generally relate to the notion that there are reports of selective sparing or deficit in these categories of words in neuropsychological impairment. Further support of this can be found in models of speech production that assume that the lexicon is organised in terms of syntactic and semantic properties of words (e.g. Levelt, 1989). Nevertheless, the status of names in the lexicon is unclear, and the lemma is under-specified in two respects:

Firstly, the nature of connectivity at the lemma has been characterised in a number of different ways. According to models based on the IAC architecture (Brédart et al. , 1995; Burton & Bruce, 1992) both excitatory and inhibitory connections exist. Each level of representation is portrayed as a separate module or pools of units. Excitatory connections project to and from the lemma pool, joining the lexical representations found in the lemma with related representations in other domains. These are the connections concerned with spreading activation. In order for competition to occur, inhibitory connections exist between all nodes within the same pool of units. Thus, names within the lexical pool of units inhibit one another (e.g. Valentine, Hollis & Moore, 1999). Models of speech production are also based on spreading activation. However, each theory holds different views regarding the nature of lexical selection. Only the model of speech production proposed by Harley (1993) includes inhibitory connections within the lemma itself . Roelofs (1999) and Levelt et al. (1999) have successfully shown that lexical selection can be explained in terms of a changing threshold. According to these explanations, proportions between active compared to inactive lemmas determine a threshold for lexical selection. In contrast Dell's (1986) model employs no inhibitory mechanism or threshold.

A further reason why the lemma is under-specified concerns the way that lexical items belong to a single syntactic class. People's names are often a lexical compound of a first (Christian) name, followed by a surname. It is not uncommon to find people whose surname is also known as a common word (such as George Bush, Roy Castle etc). At the lemma stage of processing, are these words influenced more by their semantic or syntactic properties? Clearly in respect of proper names that are a compound the lemma is under specified. Valentine et al. (1996) has characterised the internal structure of the lexicon; the proposed organisation being based on empirical research. In respect of

familiarity decision task, peoples names that are composed of a word (Such as Barbara Castle) were found to prime a lexical decision to the same word presented later as a common word (Castle) and vice versa. However, when a similar experiment involved speech production the effect was not observed (Valentine, Moore & Brédart, 1995). The results were interpreted as evidence that early in processing all entries in the lexicon were activated, but once an entry had been fully specified only specific routes remained active.

Valentine et al. (1996) have proposed a lexicon in which lemmas code a name phrase as detailed in Figure 6.2 below:
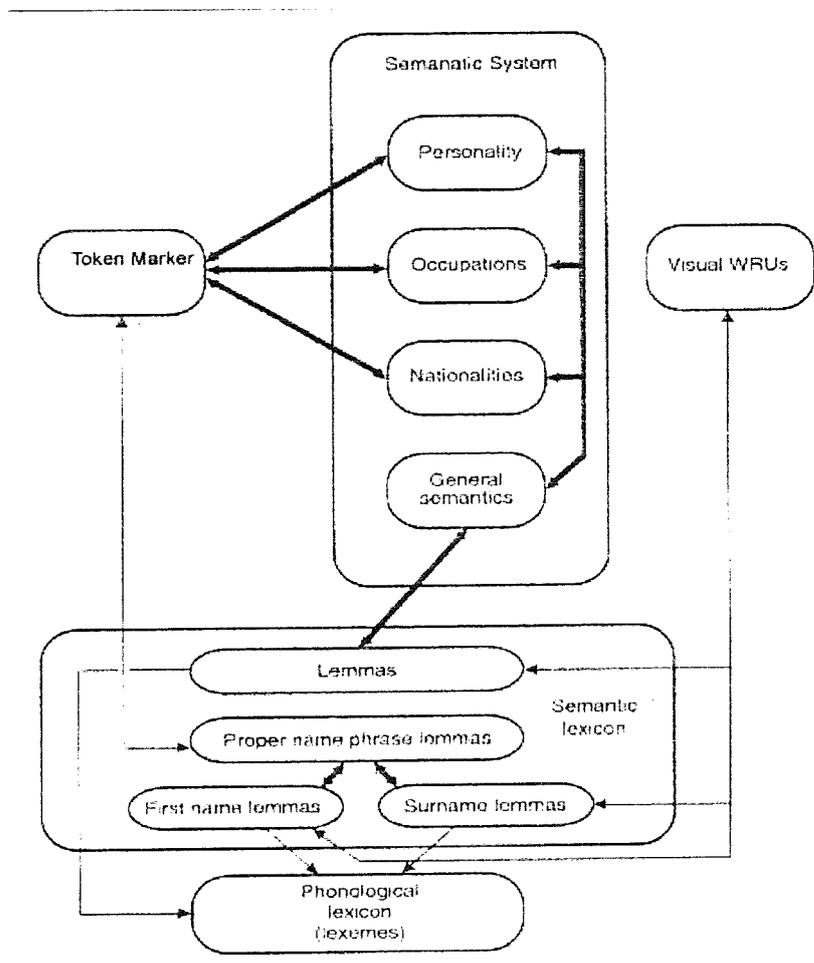
Figure 6.2: The internal structure of the lexicon, showing the organisation of the lemmas. Adapted from Valentine, Brennen and Brédart (1996).

In a series of unpublished studies by Valentine (ESRC: End of Award report, 1995) the structure of the lexicon was addressed using a semantic priming paradigm. If entries within the lexicon are shared one would expect semantic priming between a particular word presented as a proper name to a common word associated with it. (For example Ruby Wax - Candle). Would seeing the written name "Kenneth Baker" activate the meaning for the word baker over a short interval? Data suggested that priming may occur between proper names and common names. Unfortunately, the results of these studies were unclear and of low reliability. It is clear, however, that the lexicon must encompass lemmas for all elements of a lexical compound. Furthermore if priming does occur between proper names and common names, the internal structure of the lexicon may need to be amended. If responses to proper names (a compound of a first name and a surname that is also known as a common word) are able to prime a common word, then a direct connection must exist between the surname lemma, and the lemma for common names. No direct connection exists in the diagram provided by Valentine et al (1996). An alternative would be to postulate that surnames that are also common words are represented in the common name lemma.

Another way to explore the connectivity at the level of the semantic lexicon would be to look at competition rather than priming between two entities with the picture-word interference paradigm. Picture-word interference is well established as a methodology and is described in Chapter 2. Picture-word interference has recently been used to investigate processing during lexicalisation (Cutting & Ferreiria, 1999; Damian & Martin, 1999). Shriefers, Meyer & Levelt (expriment 2, 1990) used a picture-word interference paradigm to investigate lexicalisation and name production. This study was a detailed analysis of name retrieval based on

the assumption that lexical access involves two distinct stages. First the lemma stage provides access to an abstract code that is predominantly influenced by semantic and syntactic properties. This is followed by the lexeme stage when phonological information is retrieved. Shriefers et al. used a picture-word paradigm with the distracter words (related, neutral and unrelated) presented in the auditory modality. An initial experiment (Shriefers et al. , experiment 1) was used to determine what kind of item should be used to provide an appropriate "neutral". They compared silence, white noise and the word "blank". Results indicated that white noise did not produce any difference in responses compared to silence. In contrast the word "blank" produced interference but this was significantly less than that found in the unrelated presentations. They concluded that the word "blank" would act as the most appropriate neutral stimulus. In line with previous studies, a second experiment established that picture-word interference was dependent on the time course of the presentation. With an SOA of -150 ms (distracter words commenced presentation 150ms before picture) words that had a semantic relationship with the target picture interfered with naming. In contrast distracter words that were phonologically related to the target picture were found to produce facilitation when the SOA was extended to +150 ms. They concluded that there was an initial stage of lexical access (the lemma) where only meaning was activated, following by a stage that was mostly influenced by phonology. These results supported the two-stage lexical access accounts of speech production. They also indicate further support for the locus of interference in picture-name paradigm being at the level of the name retrieval. One important difference between the study by Shriefers et al. and the other studies that have been described is that Shriefers et al. presented the distracter word in the auditory modality. One might argue that auditory presentation is problematic due to timing. In the classic picture-word interference experiments, the distracter and the stimulus appear at exactly the same time. In contrast, auditory information has a temporal quality, and determining the point at which

the auditory stimulus is first recognised, may be difficult to establish accurately, unless a uniqueness point for each stimulus is calculated. However, visual presentations of picture-word pairs are also subject to criticism; words have to superimposed over the picture, or the placement of the words needs to be carefully randomised. Participants may try to use strategies such as a shift in visual attention in order to try to avoid reading the words. Although potential problems exist for each type of presentation, there appears to be a consensus in empirical findings. Semantic relationships affect processing; they have the potential to facilitate or interfere with processing.

Recently, Humphreys, Lloyd-Jones and Fias (1995) have developed a variation of the picture-word paradigm, that has been termed post-cued picture naming. In this paradigm, participants see two object pictures and after a short interval (between 500-1000ms) they are provided with a cue to name only one of them. Naming is slower when the two stimuli are semantically related. The effect is robust for picture-picture pairs and is also found for picture-word pairs. The interference effect is eliminated when the pairing occurs with two words alone, and also when the experimental task involves categorisation rather than name production. These results were analogous to those found in the classic picture word interference paradigm (Underwood, 1976; Rosinski, 1977). The locus of interference is attributed to the process of mapping semantic information onto names.

The experiments in this series aim to use picture-word interference to provide data from which one is able to infer organisation within the lemma. Initial experiments in this chapter, validate the experimental procedure. Then the same experimental procedure is used to determine whether the lexicon is organised into separate areas for proper names and common names. Relationships

between proper names and common names were manipulated using people's names that were a compound of a first name and a surname that also occurs as a common name. The issue that was being addressed was, whether the presentation of the related word *Bungalow* interfered with the naming of Roy *Castle's* face compared to an unrelated word such as *Spaghetti.* In this example a semantic relationship exists between Bungalow and Castle. If interference of this nature exists then it would suggest that links between the two representations in the lexicon do exist. However, a lack of interference would suggest that these representations reside in separate areas of the lexicon. As the interference effect depends on the relation between the distracter word and the target picture, these relationships can be manipulated and response times can be used to determine the nature of connectivity. The basic premise is that distracters that share a relationship with the target are highly connected and therefore produce more interference than unrelated distracters (Underwood, 1976; Rosinski, 1977).

Experiment 6.1

Experiment 6.1 and 6.2 aimed to use the post-cue picture naming (PCPN) procedure to study the competition between two names in the lexicon. Humphreys et al. have shown that PCPN occurs in naming tasks when both stimuli are presented in pictorial format and also when one stimulus is pictorial and the other verbal. Interference in these experiments is attributed to the link between the semantic system and the semantic lexicon (lemma). In contrast, no such effects are found when both of the stimuli are presented in the verbal format. This is consistent with previous research, and indicates that word naming can operate via a direct non-semantic route.

An initial experiment aimed to validate the PCPN procedure. The experimental stimuli were selected exclusively from common name stimuli; pictures and names were chosen from everyday objects.

The original studies of Humphreys et al. manipulated the relation between targets and distracters as a between-participants comparison. However, due to the small number of proper name stimuli that are viable targets, the effect of relation was more viable as a within-participants manipulation. In order to validate the within participant's design, Experiment 6.1 conducted the post-cue naming solely with object pictures and names. In line with the findings of Humphreys et al. it was predicted that slower responses would occur for the related pairings compared to the unrelated pairings.

Method

Participants

Twelve participants (one male and eleven females) volunteered to take part in this experiment. Ages ranged from 30-55 years. All of the people were nationals of the United Kingdom, and were attending an Open University Residential School.

Design

The experiment was a within-participants factorial design. The first factor was the format of the "to be named" target stimulus. Target stimuli were presented in either pictorial or verbal format. The relationship between the "to be named" stimuli and the item with which they were paired, was also manipulated. In all

cases one picture and one word were presented on each trial. There were two levels of relation (related, unrelated). The dependent variables were the response time (in msec) and accuracy of the verbal responses.

Materials

Two sets of picture-word pairs of stimuli were formed. The stimuli pairings were made on the basis that the picture and the word could be clearly related or unrelated. (for example, related pairings: Ambulance-Helicopter, Elephant–Kangaroo. Unrelated pairings: Ambulance-Kangaroo, Helicopter-Elephant). Each set comprised of ten picture-word pairs. For the related pairings, ten pictures (line drawings of 256 x 256 pixels) of everyday objects were paired with the name of a semantically related (categorically related but not associated) object, to form pairs of picture-word stimuli. An additional ten pairs of related pairings were produced by exchanging the pictures with words and vice versa. Therefore in total, twenty picture-name pairings formed the "related" type presentations. A list of the related stimuli pairs can be found in Appendix 8). Twenty "unrelated" pairings were formed by reorganising the pairs of stimuli once again, so that there was no longer a relationship between the picture and the word. The stimuli were prepared so that each picture-word presented side by side in the centre of the screen. All verbal stimuli (names) were presented in upper case 14pt Ariel font, and the distance between the word and the edge of the picture was 4cm on the visual display. The image of an arrow (pointing left or right) was used as a cue for naming.

Apparatus

The experiment was presented on the screen of an IBM compatible PC using Micro Experimental Laboratory (MEL2) software. Vocal responses were recorded using a voice key, attached to a throat microphone. The experimenter recorded the accuracy of the vocal response by key press.

Procedure

Participants were told that they were going to take part in an experiment about object names. All participants received a series of presentations to familiarise them with the stimuli pictures. Pictures of the practice and experimental stimuli were presented one by one in a random order for naming. If participants made an error, indicated that they were in a TOT state, or said that the image was unknown to them, they were given the correct name by the experimenter and asked to repeat it out loud. Each item was repeated until participants could produce the names successfully.

Once the participant had completed the familiarisation stage they were presented with a block of ten practice trials followed by the block of 80 experimental trials. Each of these trials consisted of a pair of stimuli that appeared on the computer screen for 900 ms. The stimulus pairing disappeared and a postcue interval of 600 ms occurred. Then an arrow appeared that pointed either right or left, indicating an item to name. The cue arrow remained on the screen until the participant made a vocal response. A single trial is portrayed in Figure 6.3 overleaf.

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Figure 6.3. The time course of an experimental trial in the postcued naming procedure. This is an example of a related trial.

TIMING

0 ms

900 ms

GIRAFFE

1400 ms   ⟵_____
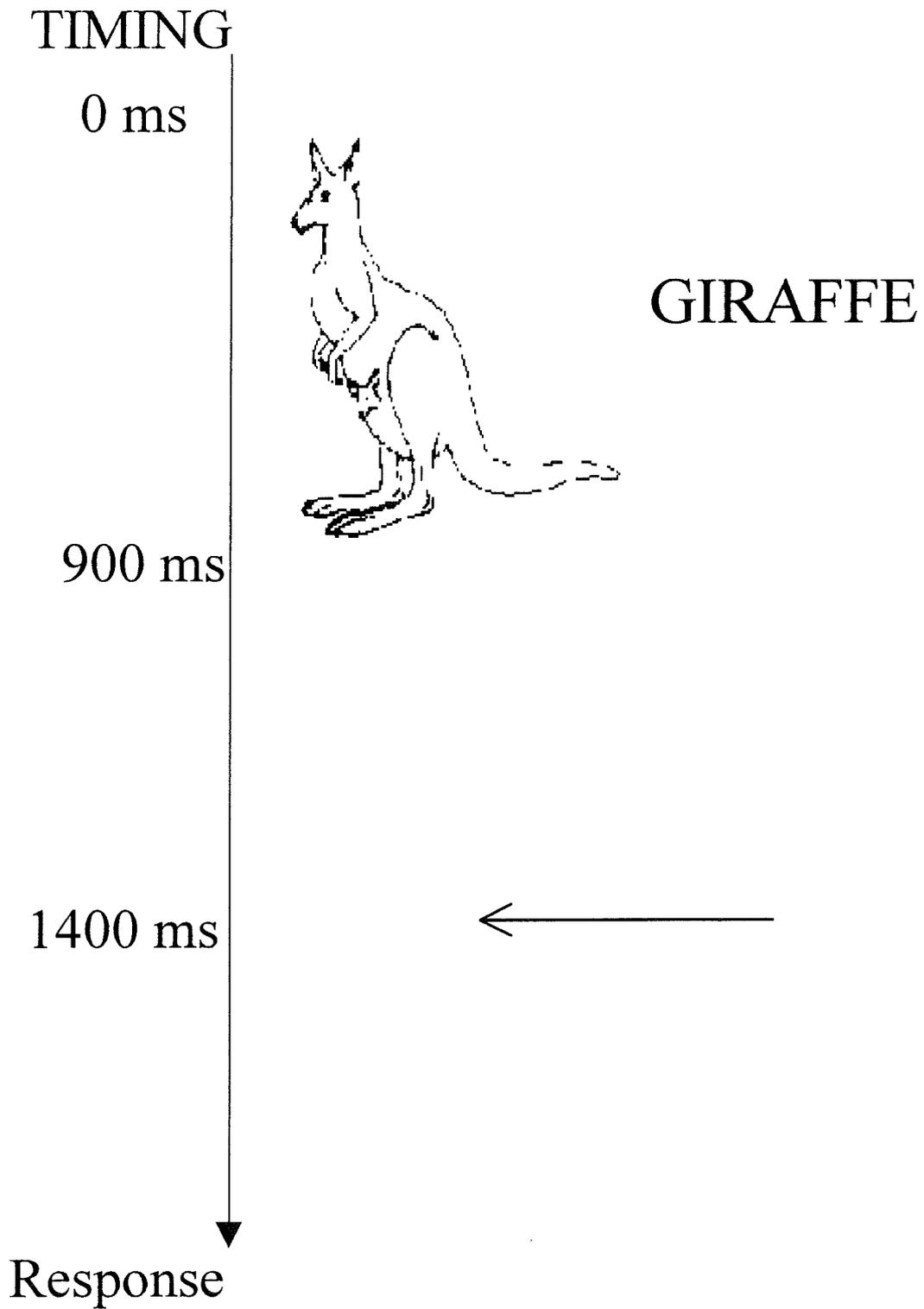
Response

After the participant had responded, the experimenter recorded the accuracy of the response by key press and then the next trial commenced. Responses were recorded as correct or incorrect (naming error/hesitation, misfire). The position of the picture/word stimuli (left or right position) and the direction of the arrow cue (left or right) pointing was randomised and there was an equal probability that the "to be named stimulus" was a picture or a word and that the cue would point left or right. There was therefore a total of 80 experimental trials. 40 trials (20 related, 20 unrelated) where the participant was cued to produce the name from a picture of object. Similarly 40 trials where the participant was cued to read the name of the object.

Results

Correct responses between 300 ms and 5000 ms were subjected to analysis. Response times outside of this range were treated as errors. The mean response times are plotted in Figure 6.4 overleaf. The mean accuracy of responses by participant can be found in Table 6.1.

Figure 6.4: Mean RT for postcue naming of picture and word targets, as a function of target-distracter relationship. Error bars show the 95% confidence interval for the effect of relation.

□ related

▨ unrelated

rt (msec)

900
850
800
750
700
650
600
550
500
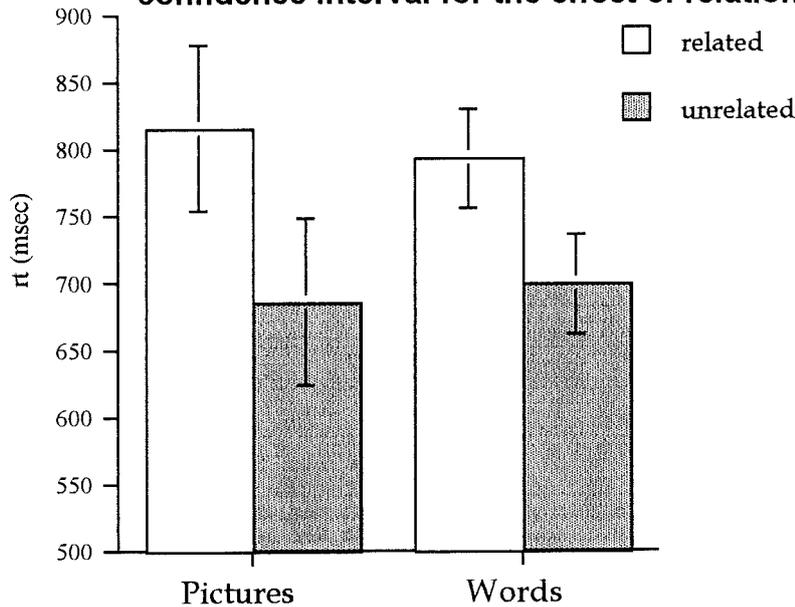
Pictures   Words

Table 6.1
Mean Response Accuracy (out of 10) for Experiment 6.1.

Naming Picture Targets

Related   9.0
Unrelated   8.1

Naming Word Targets

Related   8.4
Unrelated   8.8

Responses to the picture stimuli in the 'related' presentation were 130 ms slower than during the 'unrelated' presentation. A similar trend was found for the word stimuli, names produced during the 'related' presentation were 94 ms slower

than during the 'unrelated' presentation. The data was analysed by participant (identified by the suffix 1) and by item (identified by the suffix 2) using two separate ANOVAs, one for the picture naming responses and one for the word naming responses.

For the picture naming responses, the main effect of relation was significant in the participants analysis only $F_1(1,11) = 12.51$, $p < .01$; $F_2(1,19) < 1$. For the word naming responses, there was a main effect of relation in both analyses $F_1(1,11) = 17.95$, $p < .01$; $F_2(1,19) = 12.67$, $p < .01$

All of the original studies by Humphreys et al. manipulated the effect of relation as a between participants factor. In order to identify whether the PCPN is sensitive to repetition, and to determine whether the design would have adequate power if a further factor was introduced (as in the next experiment with common names and proper names), an additional analysis was carried out.

Two separate ANOVAs were carried out by participants and by items with repeated measures on the factor of stimulus (set A verses set B) and relation (related, unrelated). The response times for the stimuli from set A (761 ms) and set B (739 ms) were similar and the main effect of stimulus set was not significant $F_1(1,11) < 1$; $F_2(1,9) = 1.01$, $p = .33$. Pictures in the related presentation were named more slowly (815 ms) than the pictures in the unrelated presentation (685 ms). The effect of relation was significant in the participant's analysis $F_1(1,11)$ 12.51 $p < .01$; $F_2(1,9) < 1$. The interaction between relation and stimulus set was not significant $F_1(1,11) < 1$; $F_2(1,9) < 1$.

The responses to word stimuli were analysed with a separate ANOVA. Response times for stimuli for set A (740 ms) and set B (753 ms) were similar and the main effect of stimulus was not significant $F_1(1,11) < 1$; $F_2(1,9) = 1.01$, p = .33. Words in the related presentation were named more slowly than the same words in the unrelated presentation (805 ms vs. 675 ms). The main effect of relation was significant $F_1(1,11)$ 17.95 p<.01; $F_2(1,9) = 17.66$ p <.01 The interaction between relation and stimulus was not significant $F_1(1,11)$ =1.4, p = .25; $F_2(1,9)$ <1

Discussion of Experiment 6.1

The results indicate that PCPN occurs when picture and name stimuli are presented in a within-participants design. The results are in accordance with the findings of Humphreys et al. and indicate that the post cue procedure affects both picture naming and word naming when picture and word stimuli are presented simultaneously. Repetition is not considered problematic, as the number of repetitions of each stimulus remains constant in each cell. Although the effect of relation for picture naming was not significant in the items analysis, it is possible that this was due to the nature of the relationship between some of the experimental items. The second analysis indicated that the experiment had sufficient power for a second factor to be considered.

Experiment 6.2

Experiment 6.2 used the same design as Experiment 6.1 to explore whether there would be interference or competition between proper names and common names that could be viewed as having a conceptual relationship in terms of their name. It was predicted that if the lemmas are specified predominantly by conceptual classification then interference would be apparent between common name distracters and people's names that were a compound containing a word that was semantically associated to the common name distracter. If however, the organisation of the lemma is predominantly determined by syntax then it is likely that proper names and common names would not interfere with one another as they would be represented in distant locations in the semantic lexicon.

Method
Participants

Twelve participants (two males and ten females) volunteered to take part in this experiment. Ages ranged from 21-48 years. All of the subjects were nationals of the United Kingdom.

Design

The experiment was a within-participants factorial design. There were three independent variables. The first factor manipulated the format of the "to be named" stimulus. Stimuli were presented in either pictorial or verbal format . A second factor of noun category. Stimuli were either exemplars of famous people or everyday objects (proper nouns or common nouns). Finally, a third factor manipulated the relationship between the "to be named" stimuli. There were two

levels (related, unrelated). The dependent variables were the speed (in msec) and accuracy of the verbal responses.

Materials

Ten celebrity faces were matched with ten everyday objects to form pairs of stimuli. For each item a black and white digitised image of 256 x 256 pixels was formed. A selection of additional items served as practice stimuli. Each celebrity name could be considered a lexical compound of a first name and a common (object) word. The stimuli pairings were made on the basis that the celebrity name contained a word that could be clearly related or unrelated to the everyday objects. (for example related pairings: Edwina Curry-spaghetti, Tom Cruise-lighthouse. Unrelated parings Edwina Curry-lighthouse, Tom Cruise-curry). Twenty picture-name pairings of this kind formed the "related" type presentations (ten pairings where the picture was a celebrity face and ten where the picture was of an everyday object. A list of the related stimuli pairs can be found in Appendix 9.). A further twenty "unrelated" pairings were formed, where there was no obvious relationship between the celebrity item and the object item. An example of the stimuli pairings is given in Figure 6.5 overleaf.

SPAGHETTI   (related)

ELEPHANT   (unrelated)
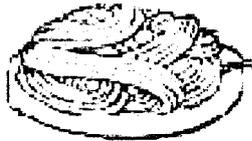
EDWINA CURRY   (related)

JOHN MAJOR   (unrelated)

Figure 6.5 An example of the stimuli pairings used in Experiment 6.2

An additional selection of ten pairings, which were not found in the experimental set, were produced to serve as practice stimuli. The stimuli were paired so that each picture-word presented side by side in the centre of the screen. All verbal stimuli (names) were presented in upper case 14pt Ariel font. The image of an arrow (pointing left or right) was used as a cue for naming.

Apparatus

The experiment was presented on the screen of an IBM compatible PC using Micro Experimental Laboratory (MEL2) software. Vocal responses were recorded using a voice key, attached to a throat microphone. The experimenter recorded the accuracy of the vocal response by key press.

Procedure

Participants were told that they were going to take part in an experiment about naming famous people and everyday objects. All participants received a series of presentations to familiarise them with the stimuli pictures. Pictures of the practice and experimental stimuli were presented one by one in a random order for naming. If participants made an error, indicated that they were in a TOT state or said that the image was unknown to them, they were given the correct name by the experimenter and asked to repeat it out loud. Each item was repeated until participants could produce the names successfully.

Once the participant had completed the familiarisation stage they were presented with a block of ten practice trials followed by the block of experimental trials.

Each of these trials consisted of a pair of stimuli that appeared on the computer screen for 900 msec. The stimulus pairing disappeared and after a postcue interval of 600 msec, a cue appeared in the centre of the screen. The cue remained on the screen until the participant had made their response. The time course of a single experimental trial is portrayed in Figure 6.6 overleaf. The experimenter then recorded the accuracy of the response by key press and then the next trial commenced. Responses were recorded as correct or incorrect (naming error/hesitation, misfire). The position of the picture/word stimuli (left or right position) and the direction of the arrow cue (left or right) pointing was randomised and there was an equal probability that the "to be named stimulus" was a picture or a word and that the cue would point left or right. There were therefore a total of 80 experimental trials. 20 trials (10 related, 10 unrelated) where the participant was cued to produce the name from a picture of the famous person. 20 where the participant was cued to produce the name from the picture of an everyday object, 20 trials where the participant was cued to read the name of the celebrity, and 20 trials where the participant was required to read the name of the object.

TIMING

0 ms

SPAGHETTI

900 ms

1400 ms
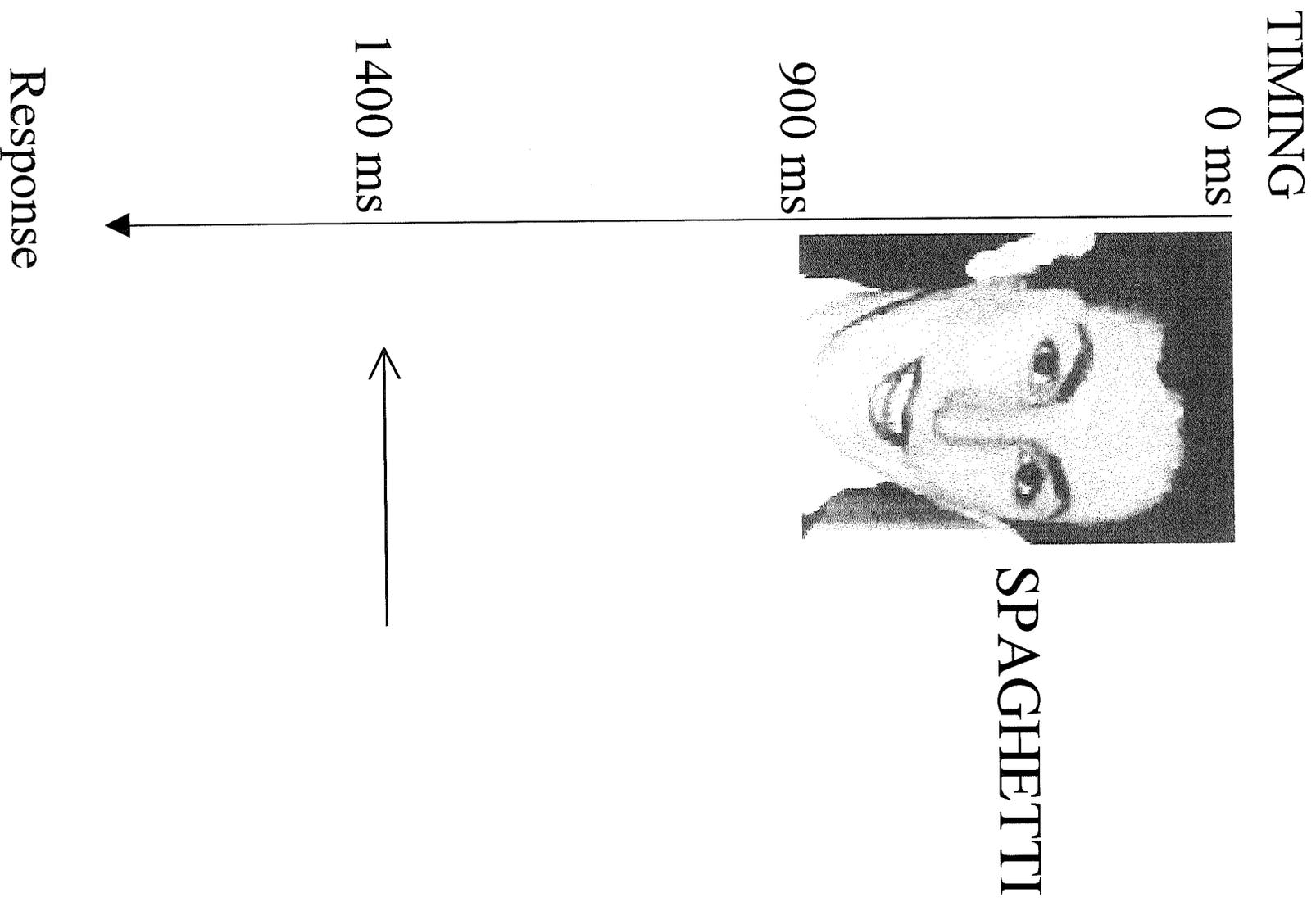
Response

Figure 6.6 The time course of a single experimental trial.

Results

Correct responses between 300 and 5000 ms were subjected to analysis. Response times outside of this range were treated as errors. Errors accounted for 9% of the total number data points. This was made up of 5 % errors from incorrect responses, 1 % from responses under 300 ms and 3% from errors over 5000 ms. The mean accuracy of responses by participant is given in the Table 6.2. The mean RT is plotted in Figure 6.7.

Figure 6.7: Mean response times for postcue naming of picture and word targets, as a function of target-distracter relationship. Error bars show the 95% confidence interval for the effect of relation.
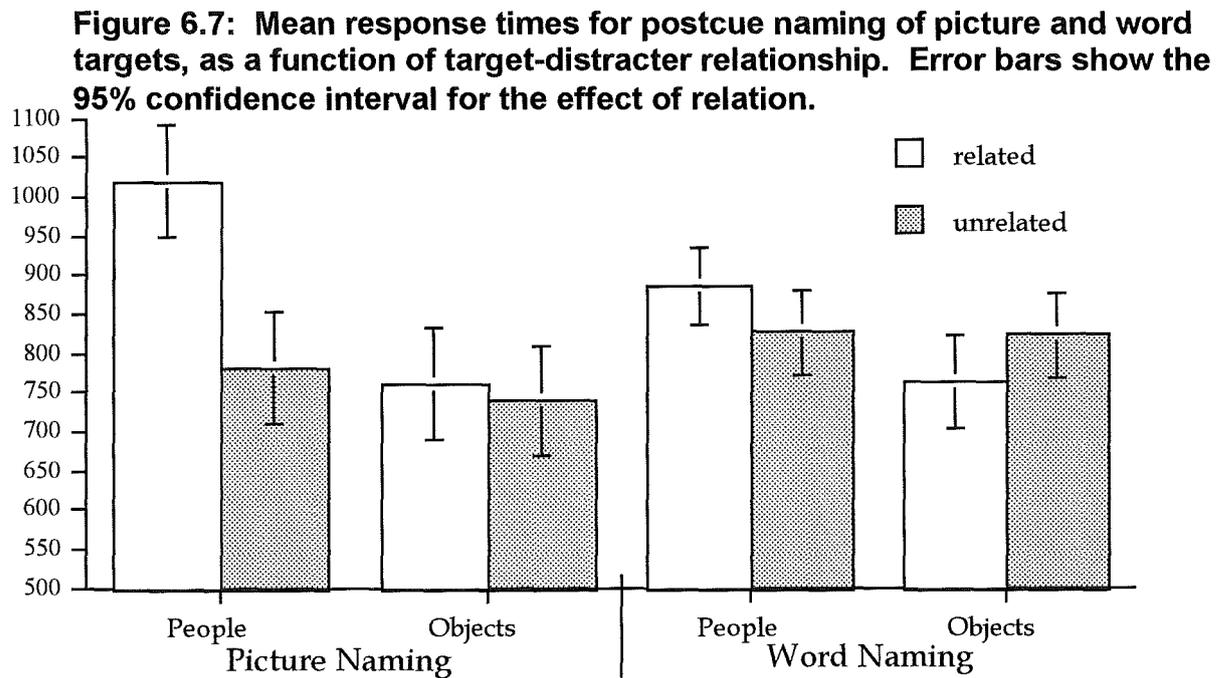
Table 6.2 Mean Response Accuracy (out of 10) for Person-Object pairs from Experiment 6.2.

Naming Picture Targets

People	related	8.3
People	unrelated	9.3
Objects	related	9.0
Objects	unrelated	8.7

Naming Word Targets

People related	8.2
People unrelated	8.8
Objects related	8.2
Objects unrelated	8.0

The data for the picture naming and word naming were subjected to analysis by two separate ANOVA's (considering picture and word naming separately) taking noun (proper name, common name) and relation (related, unrelated) as within-participants factors (identified with the suffix 1) and also by item (identified with the suffix 2).

For picture naming: The main effect of noun was significant $F_1(1,12) = 12.79$ p = .01; $F_2(1,9) = 5.1$ p = .04. The main effect of relation was significant $F_1(1,11) = 7.77$ p = .01; $F_2(1,9) = 6.07$ p = .03. The interaction between noun and relation was not significant $F_1(1,11) = 2.4$. p= .14; $F_2(1,9) = 4.49$ p < .06 . Simple main effects indicated that the relationship had a significant effect for naming people's faces [Relation for peoples faces $F_1(1,11) = 4.49$ p = .05; $F_2(1,9) = 11.22$ p = .009]. This suggested that relationship particularly affected the naming of the face stimuli. No other comparisons reached significance (All F's < 2.6, all p's > .13). In respect of the ANOVA for word naming, there were no significant differences for any of the main effects or interaction (all F's < 2.02 all p's >.67).

Discussion of Experiment 6.2

The data indicated that naming a face was much slower when there was a related common word presented as a distracter, compared to an unrelated common word. Whilst this interference effect was found for naming pictures of faces, the reverse was not found. Naming a picture of an object was not impaired by the presentation of a related person's name. No interference effect was found in the word naming trials.

General Discussion of Experiments 6.1 and 6.2

Experiments 6.1 and 6.2 have indicated that the lemmas for proper names and common names are connected in some way. Whilst, the postcue picture naming procedure is an interesting method, the presentation of the stimulus may be prone to error. The participants may be able to use strategies to predict which side to the screen to focus, or may anticipate the cue leading to speeded response times. This can be checked for by excluding response times faster than a predetermined cut-off. Humphreys et al. considered picture-word pairs to evoke word reading via a semantic route. However, it is possible that the words were processed via a direct route omitting the semantic lexicon or lemma stage. Therefore it may be more appropriate to repeat the experiment using pairs of pictures for naming rather than picture-word pairs to ensure that both stimuli evoke semantic processing via the lemma stage. The stimulus set also has the potential to be problematic; it is difficult to find categorical pairs of stimuli that are not associated to some degree. The stimuli pairs must be selected with care.

However, if the interference effects are robust, and not an artefact of the post-cue procedure or repetition, then it should be apparent in an alternative picture-word interference paradigm. Early experiments used a word superimposed over the picture, however, with face stimuli, this presentation was not considered to be appropriate. The study by Young et al. (1986) placed distracters in a speech bubble, but this also has the same draw backs as with the postcued presentation: there is more than one stimulus on the screen at the same time, and this may elicit divided attention. The most appropriate way of presenting the stimuli was considered to be that used by Shriefers et al. (1990) where participants see a single pictorial stimulus, and the distracter word is presented in the auditory modality.

Experiments 6.3 - 6.5 aim to establish whether the interference that occurred with the postcue procedure was robust. In line with the post-cued experiments, the first experiment used object stimuli only and the second experiment mixed proper names and common name distracters.

Experiment 6.3

The original experiment by Shriefers et al. included a number of different manipulations. However, as the focus of interest is access to the lemma stage of processing, it is only necessary to consider their SEMANTIC condition at a single SOA of -150 ms. In this presentation, the word is presented 150ms before the picture stimulus appears. As auditory recognition has a temporal quality, the point at which interference occurs must be leading up to the point at which the participant is preparing to name the visual stimulus. In other words the

methodology should indicate that early during lexical selection, picture-word interference should be apparent from semantically related pairings. Experiment 6.3 aimed to replicate the findings of Shriefers et al. (1990). Results would validate the procedure by considering common words alone, where both the distracter word and the target picture would be classed as common names. The relationship between the distracter and the target picture was manipulated so that the pairing could be classed as related, neutral or unrelated. In line with the original experiments by Shriefers et al. it was predicted that early during lexical selection, picture-word interference should be apparent from semantically related pairings; that the related condition would produce slower response times than the neutral and the unrelated conditions.

Method

Participants

Twelve participants took part in the experiment, (4 male, 8 female). Ages ranged from 21 – 50 years. All of the participant's were students of the Open University attending a day workshop.

Design

A one factor within-participants factorial design was used. The factor of relation, had three levels (the word-picture pairings could be classed as related, neutral or unrelated). The dependent variable was the response time to produce the name of the picture in milliseconds. In contrast to the study by Shriefers et al. (1990), the interfering stimuli were presented at a single SOA of –150. In other words the distracter preceded the picture onset by 150 ms. Each picture was presented

under three conditions (related, neutral, unrelated). In the neutral condition the interfering stimulus word "Blank" was presented with each stimulus picture. This was chosen in preference to a tone or white noise, as Shriefers et al (experiment 1) indicated that tones or white noise were not an appropriate for use as a neutral condition. In the related condition the distracter word had a semantic (categorical) relationship with the picture stimuli. Highly associated pairings were avoided. In the unrelated condition the distracter words were re-paired so that they no longer had any obvious relationship with the pictures.

Materials and Apparatus

Sixteen line drawings were selected as experimental pictures for naming (see Appendix 10). Another 4 pairings were used as practice items. Sixteen auditory distracter words were digitised at 22 kHz using Soundedit software. The duration of the distracter words ranged from 500-900ms. A further auditory file of the word "Blank" was prepared for use as a neutral stimulus. Another 3 auditory files were used as practice items. The experiment was presented on Macintosh computer using Superlab software. Reaction times were taken with a microphone attached to a voicekey.

Procedure

Participants were tested individually. In order to determine that the images were equally familiar participants were shown each of the pictorial stimuli accompanied by the desired name. The participants were asked to use these names to refer to the pictures. Once the participants had familiarised themselves with the stimuli 8 practice trials commenced, followed by the experimental trials. Participants

were told to produce the name of each picture out loud, as quickly as possible. A single trial consisted of the presentation of one of the experimental stimuli. The interfering stimuli word preceded the picture onset by 150ms. Once the participant had produced the name of the picture, the experimenter recorded the accuracy of the vocal response by key press. Each experimental picture was presented three times, once in each of the three (related, neutral and unrelated) conditions. Thus, the participant received 48 experimental trials in random order.

Results

Figure 6.8: Mean response times for naming of picture targets, as a function of target-distracter relationship. Error bars show the 95% confidence interval for the effect of relation.
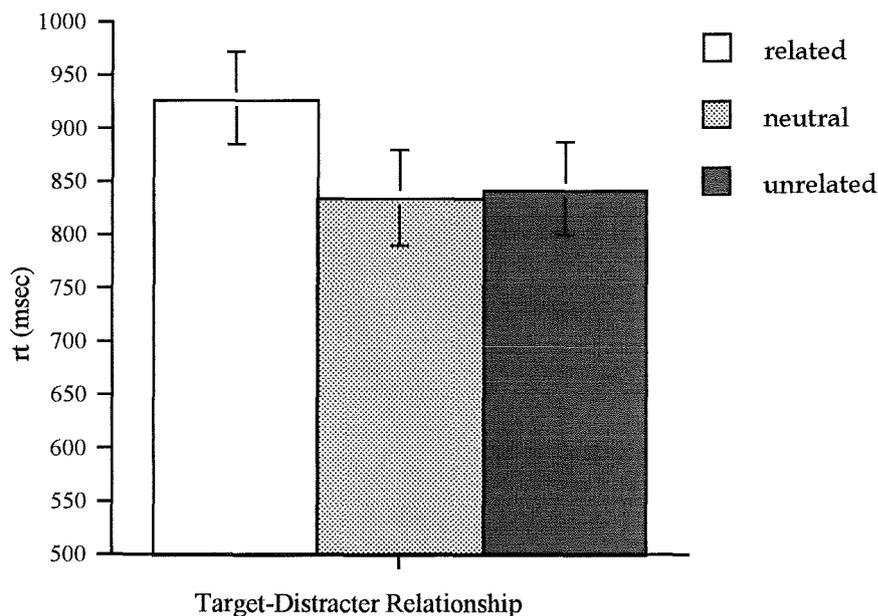
Table 6.3
Mean Response Accuracy (out of 16) for Experiment 6.3

Related	15.9
Neutral	14.9
Unrelated	13.8

Responses to the experimental items in the related, neutral and unrelated conditions were subjected to analysis. A response to an item was only included if the correct response was given and the reaction time was within a range of 300 – 5000 ms. The mean timing is given in Figure 6.8 above and response accuracy (mean number correct of 16) can be found in Table 6.3.   Repeated measures ANOVAs were conducted taking participants as the random factor (identified by the suffix 1) and also taking items as the random factor (identified by the suffix 2).

There was a significant main effect of relation. F_1 (2,11) = 3.96, p < .05; F_2 (2,15) = 4.20, p < .05. A comparison of the means indicated that the related response times were significantly slower than the neutral t_1(1) = 2.54, p < .05; t_2(1) = 2.63, p < .05 and unrelated t_1(1) = 2.32, p < .05; t_2(1) = 2.42, p < .05 response times. There was no significant difference between the neutral and unrelated response time t_1 (1) <1; t_2(1) <1.

Discussion of Experiment 6.3

Experiment 6.3 confirms that interference occurs for object names presented as per the study by Shriefers et al. The related presentation produced slower reaction times than the neutral and unrelated presentations. Therefore the semantic relation between the distracter word and the target picture slowed picture naming. The neural condition yields a baseline for naming the picture stimuli. As there were no significant differences between the unrelated and neutral conditions, one can maintain that differences between the related and unrelated stimuli are not occurring due to a speeding of the unrelated response time. The data indicate that the use of an auditory presented distracter is valid method with which to study the interference at the lemma stage of name retrieval.

Experiment 6.4

Experiment 6.4 concerned the connectivity between common names and proper names. As in Experiment 6.3 the semantic relationship between word and picture were of interest. However, this time the stimuli pictures were celebrity faces. All of the celebrities had names that contained word that was also known

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as a common name. For example, Cilla Black and Edwina Curry. The distracter words were all common names and were selected so that there was a relationship between the common names contained in the celebrity name and the distracter word. For example, Edwina Curry - Salad (Curry and Salad are both types of food). The relationship between the distracter and the target picture was manipulated in the three ways (related, neutral and unrelated) as in Experiment 6.3.

The aim of this experiment was to determine the nature of connectivity at the lemma. Some authors have suggested that the lemma is organised by syntactic class (e.g. Levelt 1989). The methodology aimed to indicate whether proper names that contain words also known in a common name form would activate these common name representations during lexical selection. If so, picture-word interference should be apparent from semantically related pairings; the related condition would thus produce slower response times than the neutral and the unrelated conditions.

Method
Participants

Twelve participants took part in the experiment, (6 male, 6 female). Ages ranged from 21 – 50 years.

Design

A one factor within-participants factorial design was used as in Experiment 6.3. The apparatus, and presentation of the experimental stimuli were the same as in Experiment 6.3. In the related condition the distracter word had a semantic

(categorical) relationship with the celebrity name. Highly associated pairings were avoided. In the unrelated condition the distracter words were re-paired so that they no longer had any obvious relationship with the celebrity names.

Materials and Apparatus

Sixteen black and white images of famous peoples faces were selected as experimental pictures for naming (see Appendix 11). Another 4 images were used as practice items. Sixteen auditory distracter words were digitised at 22 kHz using Soundedit software the duration of the distracter words ranged from 500-900ms. A further auditory file of the word "Blank" was prepared for use as a neutral stimulus. Another 3 auditory files were used as practice items. A list of the related stimuli pairings can be found in Appendix 12. The experiment was presented on Macintosh computer using Superlab software. Reaction times were taken with a microphone attached to a voice key.

Procedure

The experimental procedure was the same as that described in Experiment 6.3. Participants were familiarised with all of the experimental stimuli followed by a series of 8 practice trials. The 48 experimental trials commenced. Each stimulus picture was presented three times, once in each of the three (related, neutral and unrelated) conditions.

Results

Figure 6.9 Mean response time for face naming as a function of target-distracter relation. Error bars give the 95% confidence interval for the effect of relation.

Target – Distracter Relationship
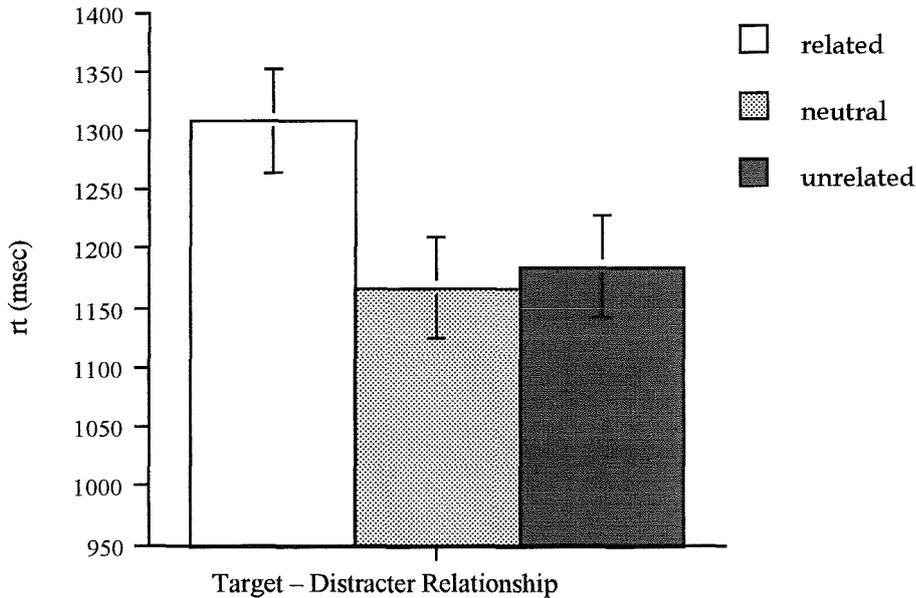
Table 6.4
Mean Response Accuracy (out of 16) for Experiment 6.4.

Related	12.5
Neutral	13.9
Unrelated	11.8

Responses to the experimental items in the related, neutral and unrelated conditions were subjected to analysis. A response to an item was only included if the correct response was given and the reaction time was within a range of 300 – 5000 ms. The mean RT is plotted in Figure 6.9 above and accuracy of responses by participants (mean number correct of 16) can be found in Table 6.4.

Repeated Measures ANOVAs were conducted taking participants as the random factor (identified by the suffix 1) and also taking items as the random factor (identified by the suffix 2).

There was a significant main effect of relation F_1 (2,11) = 8.78, p < .01; F_2 (2,15) = 5.67, p < .01 A comparison of the means indicated that the related response times were significantly slower than the neutral t_1(1) = 3.86, p < .01; t_2(1) = 3.32, p < .01 and unrelated t_1(1) = 3.34, p < .01; t_2(1) = 2.47, p < .05 response times. There was no significant difference between the neutral and unrelated response time t_1 (1) <1; t_2(1) <1.

Discussion of Experiment 6.4

Experiment 6.4 identified that a common name distracter word interferes with naming famous faces when the name of the famous person is a compound, and there is a relationship between one of the names in the compound and the distracter. In other words, interference occurred between proper names and common names. This finding supports the data for naming faces in the post-cue naming paradigm used in Experiment 6.2. However, what remains unclear is whether the reverse would be found. Would the naming of a common name, be slowed by the presentation of a proper name distracter? This became the motivation for Experiment 6.5. More general implications of the interference effects are presented in the general discussion to Chapter 6.

Experiment 6.5

Experiment 6.2 used a post-cued naming procedure to investigate the pathways to the lemma stage of representation. Although common name distracters were found to interfere with the naming of a face, evidence for the reverse; that proper name distracters would interfere with the production of a common name was weak. Experiment 6.5 adopted the Shreifer's style procedure to determine whether this finding was robust.

Method
Participants

Twelve participants took part in the experiment, (9 male, 3 female). Ages ranged from 30 – 50 years.

Design

Once again, a one factor repeated-measures factorial design was used as in Experiment 6.4. The apparatus, manipulation and presentation of the experimental stimuli were the same as in Experiment 6.4.

Materials and Apparatus

The selection of experimental items were re-formed so that a picture for each common name could be found. Sixteen black and white images of everyday objects were selected as experimental pictures for naming (see Appendix 12). Another 4 images were used as practice items. Sixteen auditory distracter words (people's names) were digitised at 22 kHz using Soundedit software the duration of the distracter words ranged from 500-900ms. As in the previous experiment, an auditory file of the word "Blank" was prepared for use as a neutral stimulus. Another 3 auditory files were used as practice items. A list of the related stimuli

pairings can be found in Appendix 12. The experiment was presented on Macintosh computer using Superlab software. Reaction times were taken with a microphone attached to a voice key.

Procedure

The experimental procedure was the same as in Experiment 6.4. Participants were familiarised with the experimental stimuli followed by a series of practice trials. The experimental trials commenced and each stimulus picture was presented three times, once in each of the three (related, neutral and unrelated) conditions.

Results

Figure 6.10 Mean response time for picture naming as a function of target-distracter relation. Error bars give the 95% confidence interval for the effect of relation.
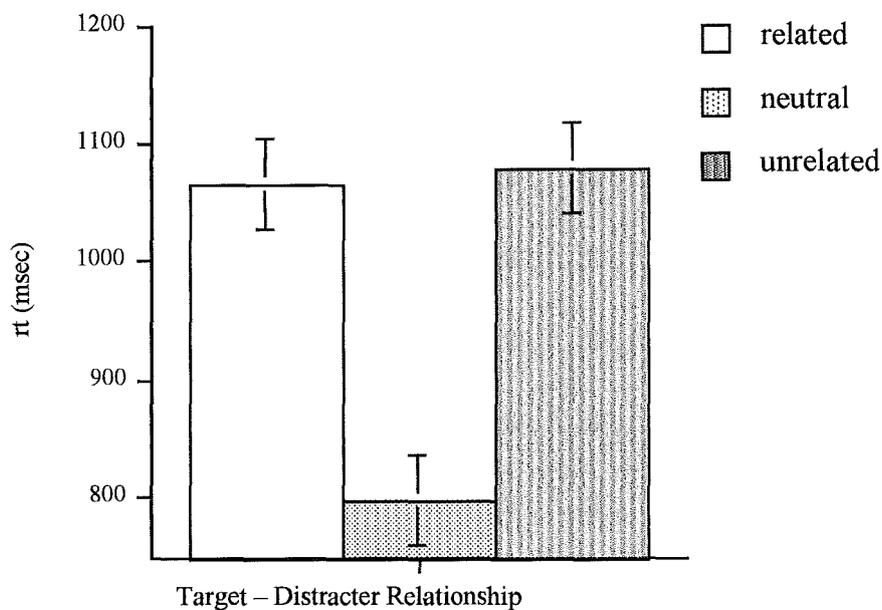
Table 6.5
Mean Response Accuracy (out of 16) for Experiment 6.5

Related	15.6
Neutral	15.0
Unrelated	15.1

Responses to the experimental items in the related, neutral and unrelated conditions were subjected to analysis. A response to an item was only included if the correct response was given. The reaction time must have been within the range of 300 – 5000 ms to be included in the analysis. The mean RT is given in Figure 6.10 and the accuracy of responses by participants (mean number correct of 16) can be found in Table 6.5 above.

Repeated-measures ANOVAs were conducted taking participants as the random factor (identified by the suffix 1) and also taking items as the random factor (identified by the suffix 2). There was a significant main effect of relation F_1 $(2,11) = 50.37$, $p < .01$; F_2 $(2,15) = 45.52$, $p < .01$. A comparison of the means indicated that the related response times were significantly slower than the neutral responses $t_1(1) = 8.49$, $p < .01$; $t_2(1) = 7.96$, $p < .01$. The unrelated responses were slower than the neutral responses $t_1(1) = 8.88$, $p < .01$; $t_2(1) = 8.54$, $p < .01$ response times. There was no significant difference between the related and unrelated response time t_1 $(1) < 1$; $t_2(1) < 1$.

Discussion of Experiment 6.5

Data from Experiment 6.5 indicates that proper name distracters do not interfere with the production of common names, as the reaction times for the related and unrelated presentations were similar. The significant differences between the related/unrelated and neutral responses indicate that participants were much faster to name the pictures when the word "blank" was presented compared to the proper name distracters. This is easily attributed to the length of the stimulus; people's names being much longer than the word "blank". A more appropriate neutral stimulus for this experiment would have been a word of similar length to the people's names. This could have been achieved by repeating the word "blank" twice in succession. Nevertheless, the crucial comparison is that of the related and unrelated responses. These indicate that proper name distracters did not interfere with the production of proper names.

General Discussion of Experiments 6.1 - 6.5

Experiments 6.1 and 6.2 used a post-cued naming procedure to investigate the pathways to the lemma stage of representation. The experiment produced significant effects for relation in the participants analysis, however, the effect of relation was not robust by items. The reason for this may have been due to the relationship between the items themselves or in the presentation (repetition, and attention to both stimuli). The procedure may also be prone to anticipatory responses. Nevertheless, the effect of relation in the participants analysis of Experiment 6.2 suggested that common names and proper names may be influenced and organised predominantly by semantic coding, in preference to the syntactic class of the names. Experiment 6.3 and 6.4 found similar interference

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effects using an alternative picture-word presentation, that overcame some of the possible problems associated with the post-cue naming procedure. Experiment 6.5 confirmed that unlike the naming of people's faces with the common name distracters, proper name distracters did not interfere with the production of common names.

A number of conclusions can be drawn from these findings. Firstly, these experiments suggest that common names and proper names may be influenced and organised predominantly by semantic coding, in preference to the syntactic class of the lexical items. Although these experiments do not exclude the possibility that syntactic coding occurs at the lemma stage, there was as much interference between the syntactic classes of proper name and common names, as there was within the same class (i.e. in the experiments the exclusively involved common names). Therefore, the interpretation of these data appear to indicate that the lemma stage is highly influenced by the semantic stage of processing. This premise complies with theories of speech production and the previous research by Shriefers et al. Semantic relations produce interference due to access at the lemma stage of processing, when the distracter is presented during the early stages of lexicalisation. The findings also support the model of proper name processing by Valentine, Brennen and Brédart (1996), indicating that it is useful for models of face naming to adopt a two-stage lexical access account of name retrieval.

Although common name distracters were found to interfere with the production of proper name targets, the reverse was not found. These differences in

interference may have occurred for a number of reasons. However, the most likely explanation is that the pictures of objects were easier to process than the people's names that were presented as distracters. The people's names were longer than the common names, and so this would have the effect of altering the relative timing of processing the two stimuli. Although this would not affect the within-participant comparison, directly comparing Experiments 6.4 and 6.5 with the same SOA may not be viable. One solution may be to use an SOA based on the mean uniqueness point of each stimulus set.

Further research is necessary to establish a more detailed understanding of the lemma and its organisation. Valentine et al. (1996) have characterised the internal structure of the lemma as depicted in Figure 6.2 at the start of this chapter. However, what is not clear is whether the surname lemmas that are also known as common words would have dual representations – as both surnames and common names. According to this diagram this would be the case. However, an interpretation of the experiments in this chapter may indicate that there may only be a single entry in the lexicon for these types of names. These lexical entries would be accessed via the semantic system, but also from a proper name phrase lemma. One possible solution is depicted in Figure 6.11 overleaf.
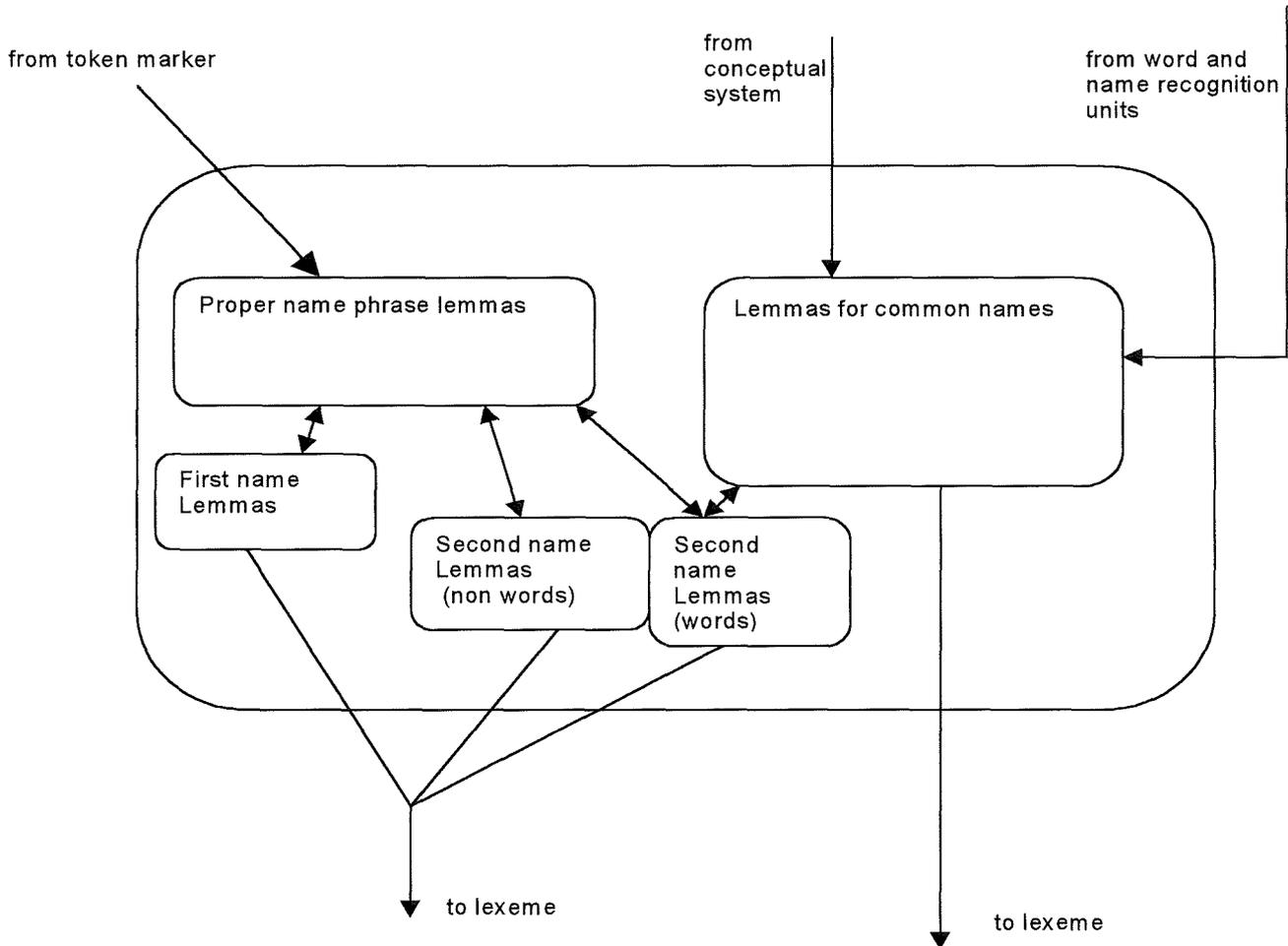
Figure 6.11.   The "adapted" organisation of the lexicon. Both proper names and common names have a noun phrase lemma.

In this diagram the structure of the lexicon is as follows: any name that is a lexical compound shares its representations with a proper name and common name phrase lemma that codes for the complete compound. An extra pool of lemmas are required for proper names that do not occur as common names. Access to the initial name phrase lemma, and the way that this node is attached to other elements in the compound may account for the reason why interference between proper names and common names occurs in a particular direction. Alternatively, the asymmetry between proper name and common name target-distracter pairings, found in the interference experiments may simply reflect that

object pictures are faster to recognise than people's faces. Therefore a different time course of interference would be expected.

Further experiments using the Shriefer's style of presentation could establish whether different SOA's affect different classes of names and how long the interference effects persist. One could also investigate the time course of semantic vs. phonological interference. Furthermore, IAC style simulation may help to identify which style of lemma organisation is most appropriate.

Chapter 7

Summary, Discussion and Conclusion

Summary of Main Results

The experiments reported in Chapter 3 address evidence reported by Durso and O'Sullivan (experiment 1, 1983). These are important issues to investigate, because any cross-domain priming that is specific to proper names and requires an abstractionist account would undermine the Valentine *et al.* (1996) model. I argued that Durso and O'Sullivan's findings may have been an artefact of their experimental design. Cross-domain repetition priming (from a picture naming task to a word naming task) that was specific to proper names may be attributed to the nature of their experimental stimuli and retrieval of a processing episode. Experiments 3.1 and 3.2 indicate that in when an experimental design is formed to eliminate episodic influences, no reliable cross-domain priming from a picture naming task onto a word naming task was found. Experiments 3.1 and 3.2 demonstrated that when an experiment is designed appropriately the data are consistent with an abstractionist account in general and with the Valentine *et al.* (1996) model in particular.

Cross–modality Priming

The experiments reported in Chapter 4 all used a cross-modality priming paradigm. Experiment 4.1 aimed to test the hypothesis that proper names would produce cross-modal facilitation from a name familiarity decision presented in the auditory modality to a name familiarity decision presented in the visual modality. These hypotheses were supported for the categories of people's names and

landmark names. Further comparisons determined that cross-modal facilitation did not occur for common names of everyday objects when presented for a lexical decision. In contradiction of the experimental hypothesis, no cross-modal facilitation was found for country names. The presence of cross-modality priming for landmark names, and the absence of cross-modality priming for country names was confirmed in Experiment 4.2. To account for the lack of cross-modal priming for country names one needs to consider the connectivity between the lemma and the conceptual system. It is likely that country names have a diffuse connectivity, from the lemma directly to the conceptual system due to the many associations of country names. The fact that they can be used as adjectives as well as nouns provide evidence of such associations. In short, country names have sense and so are not pure referencing expressions. Therefore, a familiarity decision to a country name, may be made to the basis of activity of a lemma, rather than a token marker, with activation passing from the lemma to the conceptual system directly via diffuse links. In this case, the spread of activation could by-pass the token marker-lemma link and hence no cross-modality facilitation would be found. This interpretation suggests that there are limitations for the view that all proper names are pure referencing expressions and are mediated by a token marker in memory.

One potential confound that required careful consideration was word frequency of the different categories of noun. I argued that it was unlikely that the cross-modality facilitation found with people's names and landmark names occurs as an artefact of name frequency. The people's names and landmark name stimuli used in these experiments were chosen from a selection of picture items that

participants were able to spontaneously name. For common name stimuli, an advantage for low frequency words has been found (e.g. Kinoshita, 1995, Scarborough, Cortese & Scarborough, 1977). However, an interaction between prime modality and the effect of word frequency has not been demonstrated. The possibility that differences in word frequency were responsible for the cross-modal facilitation were addressed with Experiment 4.3.

Experiment 4.3 investigated names derived from categories of high and low frequency. It might be argued that people's names and names of landmarks are labels of lower frequency and familiarity compared to the country names and object names. To test whether these differences could account for the presence of priming following cross-modality presentation, very low frequency names were compared to a set of very high frequency names using the cross-modal methodology. If frequency and familiarity were responsible for the cross-modality priming found in Experiment 4.1 and 4.2, then it is likely that this could be found when very low and very high frequency words are directly compared. If the findings of Experiment 4.1 and 4.2 occurred due to effects of word frequency, then significant cross-modal facilitation would be expected for the low frequency names, but not for the high frequency names.

A significantly greater effect of repetition was found for low frequency words was found for the visually presented prime task. However, no cross-modal facilitation occurred for high or low frequency words when presented as a familiarity decision task. Therefore, evidence of word frequency affecting cross-modal presentation was not found. As a familiarity decision task was used in Experiment 4.3 and similar results to those obtained with a lexical decision task in Experiment 4.1

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were obtained, differences in cross-modality priming due to task demands also can be eliminated.

Experiment 4.4 investigated the conceptual specificity of names, as a number of authors have suggested that people's names occupy the sub-ordinate level of a conceptual hierarchy whereas object names occupy the base level of a hierarchy (e.g. Tranel, Damasio & Damasio, 1997; Durso & O'Sullivan, 1983).

To test whether conceptual differences could account for differences in cross-modal facilitation found in Experiments 4.1 and 4.2, highly specific dog breed names were compared to a set of very general animal names using the cross-modal methodology. If a high degree of conceptual specificity is responsible for cross-modality priming then significant cross-modal facilitation would be expected for the subordinate dog breed names, but not for the general animal names.

The results clearly showed that neither specific names of dog breeds or general names of animals produce cross-modal facilitation. The lack of priming could not be attributed to a lack of power as the same stimuli produced significant facilitation when the prime phase and the test phase were presented within the same modality. The interpretation of Experiment 4.4 must be that differences in the cross-modal effects observed for the landmark and the country name stimuli, cannot be attributed simply to differences in specificity at a conceptual level. This finding refutes Durso and O'Sullivan's (1983) claim that the characteristics of proper name processing emerged as a function of their conceptual specificity. These data also confirm that common names do not produce cross-modality facilitation following a familiarity decision. This finding suggests that when the experimental task requires activation to pass from a lemma directly to the

conceptual system, no cross-modal facilitation occurs in a familiarity decision task. Furthermore, the dog breed names must be of a lower frequency than the more general animal names. Therefore these data confirm the findings of Experiment 4.3 providing further evidence that facilitation occurring in the cross-modal priming paradigm is unlikely to be influenced by an effect of word frequency.

Some proper names (such as city names and country names) can be used as adjectives as well as proper names. This flexibility of use has been identified as a possible reason why there might be a category specific sparing in proper name anomia. The next hypothesis that was explored was "adjectivisation" which was translated directly into a cross-modality experimental study (Experiment 4.5). A direct comparison was not possible for country names, as all country names could be used as adjectives. Making a direct comparison between country names and a different category of proper name would have led to confounding. Therefore the most suitable stimuli for this investigation was city names. Many city names are readily known and used as adjectives (e.g. Venice–Venetian, Canton-Cantonese). In contrast, there are some city names that do not readily form adjectives (Vancouver, Amsterdam). Experiment 4.5 found no reliable cross modal priming for city names, and there were no differences in facilitation between city names that could form well known adjectives compared to those known only in their proper name form.

Priming following Name Production

The experiments in Chapter 5 investigated facilitation of a name familiarity decision, from a prime task that required name production. Experiment 5.1 compared the facilitation of a name familiarity decision task from a prime task involving either name production, a picture familiarity decision or a name familiarity or lexical decision task. The methodology and rationale were adapted from Valentine et al's (1998) study of people's names. The aim was to determine whether name production would facilitate the visual recognition of the same items name, for people's names, landmark names and country names.

Experiment 5.1 found that naming a famous face or landmark facilitated a subsequent familiarity decision to that same item's name. In contrast, producing a country name did not provide similar facilitation. Similarly, naming a picture of an everyday object did not facilitate a lexical decision to the same items name. These patterns of facilitation were consistent with those found for the cross-modality facilitation.

Although recent research suggests that facilitation can cross stimulus domain between words and pictures for common names, support for this was not found in the present data. Park et al. (1998) used a recognition task at test (have you seen this item previously? yes/no) following a prime task involving naming and a word stem completion task. In contrast the experiments reported in this thesis employed a name familiarity decision (is this a name of a familiar item? yes/no). Park et al.'s recognition task required explicit recall whereas the name familiarity decision does not require recall of the priming episode. The data in Chapter 5 supports the view based on earlier research that naming a picture of a common object does not facilitate subsequent recognition (lexical decision) of the same

items name (e.g. Morton, 1979; Winnick & Daniel, 1970; Scarborough et al. 1979).

It might be argued that the images of maps and landmarks were not as memorable as the pictures of landmarks and faces in terms of visual familiarity or complexity. These facets of the visual image may have made the landmark stimuli prone to an episodic influence compared to the country name stimuli (although note that the images were not presented during the test task). In order to determine whether such a factor could account for the differences in the processing of landmark and country names, Experiment 5.2 was conducted. Participants produced landmark or country names from the same pictorial stimulus. Differences in facilitation from production of the landmarks and country names were still apparent, and therefore these data provided further support for the idea that processing of names of landmarks and countries differed in their underlying cognitive architecture.

Picture-word Interference

In the final experimental chapter (6) five experiments employed variations of the picture-word interference paradigm to investigate access to the lemma stage of representation. The first two experiments used a post-cued naming paradigm. It was found that seeing a common name was found to interfere with the production of a proper name when there was a conceptual relationship between the proper name target and a common name distracter. The reverse pattern of interference was not found. Seeing a proper name was not found to interfere with the production of a common name. Experiment 6.3 and 6.4 found similar interference effects using an alternative picture-word presentation, that

overcame some of the possible problems associated with the post cue naming procedure. Hearing a common name was found to interfere with the production of a proper name when there was a semantic relationship between the proper name target and a common name distracter. Experiment 6.5 confirmed that interference in the reverse direction was not found. Hearing a proper name was not found to interfere with the production of a common name.

Theoretical Analysis of Empirical Findings

Previous theoretical accounts have claimed that uniqueness, meaninglessness or conceptual specificity can account for the characteristics of proper name processing. These theories were introduced in Chapter 1. This discussion will address each theory, in light of the data reported in Chapters 3-6. It may be argued that there is a problem of differentiating between these different theoretical claims. This problem is inherited from previous publications which make large and unsupported generalisations from studies of people's names. However, with care, direct quotations can be used to disambiguate each theoretical position in turn.

Uniqueness of Names

According to Burton and Bruce (1992) the characteristics of proper name processing occur as a function of their uniqueness. People's names are difficult to retrieve from memory as they are unique pieces of semantic information. Names receive less activation from the token marker (PIN) than other semantic information that is shared by any number of identities. Accordingly, Burton and

Bruce's account assumes that people's names and unique semantic information has the same status and would predict that a) all unique names would produce consistent phenomena and b) impairments in processing would affect people's names and other kinds of unique semantic information. The current series of experiments are difficult to reconcile with an explanation in terms of uniqueness, as people's, names, landmark names and country names are all unique. For example, there is only one Bill Clinton, one Statue of Liberty and one United States of America. In spite of their uniqueness these stimuli produce different cognitive phenomena.

Other authors have also challenged the idea that the characteristics of proper name processing can be simply attributed to uniqueness (e.g. Hanley, 1995; Harris and Kay 1995). Harris and Kay (1995) provided a neuropsychological study of patient BG whom could access "unique" semantic information for familiar people who she was no longer able to name. This case remains difficult to explain in terms of the Burton and Bruce IAC architecture, unless changes to connectivity within the semantic pool of units is proposed. In response to Harris and Kay's criticism, Bruce, Burton and Walker (1994) point out that the IAC architecture: is not incompatible with accounts of naming difficulty couched in terms of relative meaningfulness, imageability, frequency or any other properties which would be expected to affect ease of learning, or retrieval, from memory. However, the categories of proper name that are used in this study involved unconscious retrieval from memory. The experiments demonstrate that the same experimental paradigm does not produce effects due to factors such as imageability and name frequency. Therefore, these data provide an additional

source of evidence that challenges Burton and Bruce's IAC architecture and explanations of uniqueness.

Meaninglessness of Names

According to Cohen (1990) meaninglessness is the critical factor that influences the retrieval of proper names. People's names are meaningless labels that lack semantic associations. A meaninglessness hypothesis has also been proposed by Brédart (1993). According to Brédart, labels themselves can provide meaning (e.g. Daffy Duck is a duck).

Differences between the categories of proper name found in the cross-modality and cross-domain repetition priming experiments, cannot be accounted for in terms of meaninglessness. Landmark names often contain information about the nature of the place (for example Tower Bridge is a bridge etc.). In this respect, landmark names are meaningful and often contain a greater degree of sense compared to people's names that can be considered arbitrary and meaningless. Despite landmark names being relatively meaningful labels, they appear to be processed in a similar way to arbitrary labels such as people's names.

It could be maintained that it is not the sense of the label, but their semantic associations that are the key factor in the meaningless proposal.

One similarity between the names of cities, landmarks and countries is that they all have many semantic attributes. Therefore, the presence of cross-modal and

cross-domain facilitation in the landmark names must be attributed to the mediation by a token marker, rather than to connectivity between the conceptual system and the output lexicon directly. If diffuse, direct connections between the conceptual system and the output lexicon were being utilised, cross-modal and cross-domain facilitation would not be expected (or at least be reduced) for the landmark stimuli.

The same interpretation could be applied to the fact that both country names and city names can be used as adjectives. This flexibility would require diffuse connectivity directly between the conceptual system and the lexicon (lemma). It might be argued that this connectivity (rather than that of the token marker – lemma) is responsible for the lack of priming following name-production and presentation in a different modality. However, if this were the case, cross-modal and cross-domain priming would be expected for the city names that were not readily known in an adjective form. The reason for this is that these city names would have a low level of connectivity between the conceptual system and the lexicon (lemma). Therefore, priming similar to that found for the other kinds of meaningless labels would be expected.

Cohen (1996) maintains "there is a gradient of difficulty that runs from names of acquaintances, to famous names, to geographical names. Famous names (like Napoleon) or place names (like the Taj Mahal) tend to have more semantic associations than names like Ann or Michael" (Cohen, 1996 p.134). There is little indication from the repetition priming experiments contained in this thesis, to support the idea of a gradient of difficulty. However, other experiments could be

conducted to test the idea of a gradient of difficulty directly (see later discussion headed "future directions").

What appears to differ in these classes of stimuli, is the nature of reference for these names. The landmark names and the people's names differ from city names and country names as they are pure referencing expressions; landmarks and people are both unique referents with only an individual identity requiring processing via a token marker.

Proper Names as Pure Referencing Expressions

If the key to proper name processing is the fact that they are pure referencing expressions, then one would expect that only sub-categories of proper name that have pure reference would produce phenomena that we usually associate with proper names. People's names can be deemed to be pure referencing expressions, whereas country names have sense and so cannot be pure referring expressions. In respect of landmark names, the case is unclear. Some landmark names are clearly pure referencing expressions: For example, the name "Taj Mahal" clearly offers no information about its conceptual properties (unless of course you speak Punjabi or Urdu). In contrast, other landmark names may have limited sense. For example, Tower Bridge, is a bridge. However, in names such as this the sense may not be appropriate (For example, Tower could relate to the building next to the bridge (The Tower of London) or to the bridge construction (comprises of two towers). For this reason one may conclude that the sense contained in landmark names is limited or false, and therefore landmarks can be classed as pure referencing expressions. Finally, city names

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require careful consideration. In their noun form, city names do not convey sense in the same way as country names. However, in their adjectival form, cities do have sense. Therefore, city names cannot be easily classified as pure referencing expressions.

The model by Valentine *et al.* (1996) can explain the cross-modality and cross-domain priming found with people's names and landmark names, if one assumes that it is pure reference (and identity) that is captured by the model. Country names and city names do not produce facilitation of this nature as their linkages between representations are more diffuse and direct. Due to the generality of their links between the conceptual system and the lemma, access would not require mediation via a token marker. The data therefore comply with the model proposed by Valentine, Brennen and Brédart (1996) extending the role of the token marker to classes of proper name other than peoples names (i.e. landmarks). The data also demonstrate that the role of a token marker is not universal for all categories of proper name (i.e. not country names or city names). Token markers provide a means of implementing pure reference in the theoretical model proposed by Valentine et al. (1996).

Organisation of the lexicon

The data presented in this thesis yields some general indications for models of speech production and face recognition. Firstly, the conclusion of the experiments contained in Chapter 6 is that common names and proper names may be influenced and organised predominantly by semantic coding, in preference to the syntactic class of the names. Although these experiments do

not exclude syntactic coding occurring at the lemma stage, there was as much interference *between* the syntactic classes of proper name and common names, as there was *within* the same class of names (i.e. in the experiments that exclusively involved common names). Therefore, these data appear to indicate that the lemma stage is highly influenced by the semantic stage of processing. This is consistent with theories of speech production, and with the model of proper name processing by Valentine, Brennen and Brédart (1996). Nevertheless, the data may indicate that it may not be necessary to fractionate the lemma stage of processing into separate areas for the processing of proper names (People's names) and common names such as proposed in the architecture by Valentine, Brennen and Brédart (1996).

In respect of models of face recognition, such as the IAC model (Burton, Bruce and Johnston, 1990) it has often been assumed that the IAC architecture can account for object processing. Although IAC may produce a viable account of early visual processing and of semantic priming, this thesis has identified differences between categories of stimuli at the level of the lexicon. The interference effects reported in Chapter 6 may present problems for the IAC style account. Whilst IAC has the potential to simulate semantic priming of people's faces, its utility to account for selective inhibitory mechanisms is doubtful. Each pool of units has a uniform strength of inhibition. What emerges from Chapter 6 is that inhibitory mechanisms exist between different categories of stimuli. Furthermore, this inhibitory mechanism does not appear to have a bi-directional strength. Therefore it is not viable to generalise with IAC in its present from, unless one hand-wires each connection strength individually.

To account fully for the process of lexicalisation, a more elaborate architecture is necessary. In the development of theoretical models such as the one proposed by Valentine, Brennen and Brédart (1996) lexical information has been represented separately from conceptual information, in line with models of speech production.

Whilst models of face recognition and proper name processing have detailed excitatory connections, relatively little concern has been placed on the nature of inhibition between different representations. Chapter 6 indicates that the time has now come to specify these inhibitory connections more accurately.

Future Directions

Attempts to differentiate between the theoretical positions of uniqueness, meaninglessness and pure reference may be compromised due to the ambiguities of the hypotheses that were inherited from the original sources. There is a danger of a circular argument. One future aim would be to operationalise a test of whether an item is a pure referencing expression.

Cross-modality and cross-domain priming could be used to explore different classes of proper names, such as mountains, rivers, oceans, counties and towns. Potential experiments may include investigations of what would happen if the adjectival form of a city name (e.g. Italian) was presented in a cross-modal priming paradigm. This may help to clarify how lexical access occurs for words with multiple uses.

Comparing different categories of proper name with a factorial design may provide a more direct test of the gradient of difficulty hypothesis. For investigation of this hypothesis comparisons of small differences in the magnitude of facilitation may be problematic. A useful alternative, may be to see whether regression of a meaningfulness rating can be used to predict the magnitude of facilitation. Regression may be useful as problematic factors (such as familiarity and frequency) have the potential to be partialed out of the model.

Other viable questions emerge when one considers the case of trade names. Trade names start as product names, but as they become well known they have the potential to act as concepts or categories (for example, the name Hoover). Can differences such as these be identified with cross-modal and cross-domain repetition priming? One prediction might be that cross-modal and cross-domain repetition priming occur whilst a product name remains a pure referencing expression. It would be predicted that as a name changes into a common noun or generic form that is more conceptual, the connectivity between the lexicon and the conceptual system would become more diffuse. Hence, cross-modal and cross-domain effects would be reduced or eliminated.

Another area of interest is the organisation of lemmas involved in lexical access. This is currently receiving great research interest (e.g. Damian & Martin, 1999; Kempen & Huijbers, 1983; Cutting & Ferreira, 1999; Miozzo & Caramazza, 1999). Valentine et al. (1996) described the internal structure of the lexicon, where a

lemma exists for each lexical entry, including lexical compounds. Whilst a large volume of work exists regarding semantic and phonological processes involved in speech production, less emphasis has been placed on words from different sub-categories and classes. Proper names such as people's names and names of landmarks are interesting as they are lexical compounds. Further research using lexical compounds would help to specify the organisation of the lemma. A comparison of different nouns, may also help to enhance our general understanding of lexicalisation. Further experiments using the Shriefer's style of presentation or Postcued picture naming could establish whether different syntactic classes of words are affected in the same way. Manipulation of the SOA's may further our understanding of the time course of lexicalisation.

In addition, would compounds from different classes of name be organised by a name phrase lemma as proposed in Chapter 6? If so, interference would be expected for other classes of lexical compounds (e.g. landmark names and common names such as Lighthouse).

Finally, connectionist style simulations could be used to identify potential hypotheses and indicate the adequacy of any number of potential alternatives to lexical organisation. Valentine, Hollis and Moore (1999) have already used an IAC style architecture to identify new experimental hypotheses. IAC simulation suggested that a) people should be slower to produce the names of famous people for whom two names are available, than they would be to name an equally familiar person for whom only one name is known; b) Naming should only slowed by a competing name, but not by a conceptual property. This was termed "the nominal competitor effect". This effect was contrasted with the semantic

competitor effect. These effects were confirmed with empirical investigation. A similar architecture could be formed to provide a simulation of the lemma stage, to provide new hypothesis for picture-word interference experiments. Valentine, Hollis and Moore (1999) assert that, in contrast to semantic competitor effects (such as in classic picture-word interference studies), nominal competitor effects are long lasting. Connectionist style simulation and empirical research could be used to compare semantic and lexical competitor effects, to clarify the precise nature of differences in the processing common names and classes of proper names.

Conclusions

The data reported in this thesis indicate that it is pure reference that is captured in a model such as that proposed by Valentine *et al.* (1996) in terms of the token marker-lemma linkage. The observed cognitive phenomena of cross-modal and cross-domain priming appear to reflect the processing of purely referring expressions.

In summary, the data reported in these experiments support the model proposed by Valentine, Brennen and Brédart (1996) being extended to some classes of proper name other than peoples names (i.e. landmarks). The data also demonstrate that the role of a token marker is not universal for all categories of proper name (i.e. not country names).

It has been argued that the model by Valentine et al (1996) provides the most comprehensive account of proper name processing available to date. However, further research is now required to specify inhibitory mechanisms, and to specify the organisation and connectivity at the lemma.

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Appendices

Appendix 1: Experimental Stimuli used in Experiment 3.1

Critical Items

People	Landmarks	Objects
SET A Items		
Ruby Wax	Eiffel Tower	Ironing Board
Margaret Thatcher	Ayers Rock	Spinning Wheel
Ken Dodd	Empire State	Pin Cushion
Terry Wogan	Statue of Liberty	Coat Hanger
Les Dawson	Notre Dame	Ice Cream
Marilyn Monroe	St. Pauls	Roller Skate
Bruce Forsyth	Acropolis	Frying Pan
Joanna Lumley	Niagara Falls	Record Player
Cilla Black	Brandenberg Gate	Cotton Reel
Tina Turner	Tower Bridge	Sea Horse
SET B Items		
Victoria Wood	Arc de Triomphe	Sewing Machine
John Major	White House	Light Bulb
Rowan Atkinson	Golden Gate	Clothes Peg
Tommy Cooper	Buckingham Palace	Fire Engine
Jimmy Saville	Tower of Pisa	Filing Cabinet
Bette Davis	Taj Mahal	Stop Watch
Johnathon Ross	Mount Rushmore	Rocking Chair
Ben Elton	Piccadilly Circus	Tennis Racket
Julie Walters	Big Ben	Traffic Lights
Michael Caine	Stonehenge	Rolling Pin

Note: In all experiments the assignment of Set A or B as primed or unprimed stimuli was counterbalanced between participants.

Appendix 2:   Experimental Stimuli used in Experiment 3.2

SET A

Empire State

Mount Everest

Tower of Pisa

Piccadilly Circus

Harrod's

Buckingham Palace

Ayers Rock

Tower Bridge

White House

Set B

Notre Dame

Acropolis

Great Wall

Statue of Liberty

Eiffel Tower

Niagara Falls

Taj Mahal

Big Ben

Stonehenge

Appendix 3: Experimental Stimuli in Experiment 4.1 and 5.1

Set A followed by Set B

Everyday Object Names

CROWN
KANGAROO
TELEPHONE
LOBSTER
THIMBLE
LADDER
WATCH
PIANO
SCISSORS

TRAIN
ALLIGATOR
KETTLE
WINDMILL
BUTTERFLY
CANDLE
UMBRELLA
VIOLIN
AEROPLANE

Country Names

EGYPT
PORTUGAL
TURKEY
ITALY
GERMANY
ISRAEL
WALES
MOROCCO
CYPRUS

SPAIN
FRANCE
CANADA
ENGLAND
GREECE
INDIA
IRELAND
BRAZIL
JAMAICA

People's Names

RUBY WAX
MARILYN MONROE
TONY BLAIR
JOANNA LUMLEY
SYLVESTER STALLONE
MARGARET THATCHER
FREDDIE MERCURY
MICHAEL JACKSON
CILLA BLACK

WHOOPIE GOLDBERG
JOHN MAJOR
TERRY WOGAN
BARBRA STREISAND
DAVID BOWIE
RICHARD BRANSON
TINA TURNER
ROWAN ATKINSON
BILL CLINTON

Famous Landmarks

ACROPOLIS
BIG BEN
EIFFEL TOWER
GREAT WALL
STATUE OF LIBERTY
NIAGARA FALLS
PICADILLY CIRCUS
TAJ MAHAL
STONEHENGE

BRANDENBERG GATE
EDINBURGH CASTLE
GOLDEN GATE
MOUNT RUSHMORE
TOWER OF PISA
EMPIRE STATE
TOWER BRIDGE
WHITE HOUSE
AYERS ROCK

Appendix 4

Critical Stimuli for Experiment 4.3

	Letters	K-F Frq.	Fam.	Con		Letters	K-F Frq.	Fam.	Con
Low Frequency Set A					**High Frequency Set A**				
BEETLE	6	0	503	619	CHURCH	6	384	560	587
BLEACH	6	0	549	544	WORLD	5	787	607	532
BURNER	6	0	518	500	WATER	5	442	641	616
CINNAMON	8	0	515	599	GOVERNMENT	10	417	594	426
PIMPLE	6	0	557	579	PEOPLE	6	847	628	540
PUDDING	7	0	510	593	STATE	5	808	560	440
BRACELET	8	1	547	602	NIGHT	5	411	636	469
COOKIE	6	1	585	634	HOUSE	5	591	600	608
MOSQUITO	8	1	512	595	PERSONAL	8	196	311	408
Mean Ratings	**6.7**	**0.3**	**532.88**	**585.0**	**Mean Ratings**	**6.13**	**562.3**	**572.1**	**504.8**
Low Frequency Set B					**High Frequency Set B**				
GORILLA	7	0	554	620	FAMILY	6	331	607	525
LETTUCE	7	0	565	579	LITTLE	6	871	594	378
DOUGHNUT	8	0	566	606	PLACE	5	571	612	427
SAUCER	6	0	533	606	CHILDREN	8	355	608	582
SPARROW	7	0	523	629	UNIVERSITY	10	214	622	533
TOASTER	7	0	520	579	GENERAL	7	494	568	408
SLEIGH	6	0	531	613	UNDER	5	707	544	319
BLOUSE	6	1	562	640	SMALL	5	542	616	402
PARCEL	6	1	503	525	SCHOOL	6	492	582	573
Mean Ratings	**6.81**	**0.31**	**537.2**	**593.1**	**Mean Ratings**	**6.50**	**530.7**	**593.2**	**452.7**

Appendix 5:
Critical Stimuli for Experiment 4.4

SET A

BULLDOG, ROTTWEILER, IRISH SETTER, GREY HOUND, GREAT DANE, DALMATION,BOXER, POODLE, ALSATIAN

ELEPHANT, SHEEP, KANGAROO, SHARK, ALLIGATOR, DONKEY, PENGUIN, SEA HORSE, BUTTERFLY

SET B

WHIPPET, KING CHARLES, DOBERMANN, BEAGLE, DACHSHUND, PEKINGESE, CORGIS, AFGAN HOUND, LABRADOR

GIRAFFE, PEACOCK, FROG, GOAT, LEOPARD, SPIDER, BEAR, GORILLA, SQUIRREL

Appendix 6: Experimental Stimuli used in Experiment 4.5

Set A

Peking	Newcastle
Manchester	Amsterdam
Rome	Birmingham
Glasgow`	Dusseldorf
Naples	Barcelona
Athens	Tangier
Nice	Lisbon
Mexico	Zurich
Tunis	Berlin

Set B

Paris	Madrid
Alexandria	Delhi
Florence	Edinburgh
Canton	Dublin
Vienna	Vancouver
Venice	Sydney
Algiers	Washington
Cuba *	Toronto
Liverpool	Shanghai

*Note: Cuba is not classed as a city name, but is a country name that is also commonly used in an adjectival form.

Appendix 7: Experimental Stimuli used in Experiment 5.2
Set A followed by Set B

Country Name   Landmark Name

CHINA   GREAT WALL
INDIA   TAJ MAHAL
ENGLAND   BUCKINGHAM PALACE
CANADA   NIAGARA FALLS
ITALY   TOWER OF PISA
DENMARK   LITTLE MERMAID
EGYPT   ABU SIMBEL
ISRAEL   WAILING WALL
SPAIN   SEGRADA FAMILLIA

IRELAND   BLARNEY STONE
UNITED STATES   STATUE OF LIBERTY
AUSTRALIA   AYERS ROCK
FRANCE   EIFFEL TOWER
GERMANY   BRANDENBERG GATE
SCOTLAND   EDINBURGH CASTLE
TURKEY   BLUE MOSQUE
GREECE   ACROPOLIS
PERU   MACHU PICCHU

Appendix 8:   Experiment 6.1 Stimuli (Related - Object only pairs)

WINDMILL - LIGHTHOUSE
SCREWDRIVER - CHISEL
SCISSORS - THIMBLE
PINEAPPLE - GRAPES
HELICOPTER - AMBULANCE
SKUNK - OSTRICH
CHERRY - PUMPKIN
KANGAROO - ELEPHANT
SEA HORSE - TORTOISE
TRUMPET – ACCORDION

Appendix 9: Experimental Stimuli used in Experiment 6.2 (Related Person-Object pairs)

DAVID SOUL - COFFIN
TOM CRUISE - LIGHTHOUSE
QUENTIN CRISP - POTATO
CILLA BLACK - ORANGE
CARY GRANT - MONEY
JOHNATHON KING - JUDGE
WAYNE SLEEP - PILLOW
ROY CASTLE - BUNGALOW
RUSS ABBOT - PRIEST
EDWINA CURRY - SPAGHETTI

Appendix 10: Experimental Stimuli used in Experiment 6.3

CLARINET - PIANO
MOSQUITO - SPIDER
PIN CUSHION - THIMBLE
BRACELET- WATCH
LADLE - KNIFE
SCARF - TROUSERS
NOSE - FINGER
PEAR - STRAWBERRY
CANOE - TRAIN
TOMATO - GRAPES
POTATO - ONION
GIRAFFE- KANGAROO
AEROPLANE - MOTORBIKE
SNAIL - TORTOISE
TRUMPET - GUITAR
WORM – BUTTERFLY

Appendix 11: Related Stimuli pairings for Experiment 6.4

HAMBURGER - ANNEKA RICE
BUNGALOW - ROY CASTLE
NIGHT - WAYNE SLEEP
LIGHTENING - DAVID FROST
ELBOW - MICHAEL FOOT
OCTOPUS - MICHAEL FISH
SPAGHETTI - EDWINA CURRY
PLASTIC - RUBY WAX
GHOST - DAVID SOUL
PRESIDENT - JONATHON KING
LIGHTHOUSE - TOM CRUISE
SANDWICH - QUENTIN CRISP
MONEY - CARY GRANT
SHRUB - GEORGE BUSH
PRIEST - RUSS ABBOT
ORANGE - CILLA BLACK

Appendix 12: Related Stimuli pairings for Experiment 6.5

HAMBURGER - ANNEKA RICE
BUNGALOW - ROY CASTLE
*MOON - WAYNE SLEEP
LIGHTENING - DAVID FROST
ELBOW - MICHAEL FOOT
OCTOPUS - MICHAEL FISH
SPAGHETTI - EDWINA CURRY
*IRON - RUBY WAX
GHOST - DAVID SOUL
*JUDGE - JONATHON KING
LIGHTHOUSE - TOM CRUISE
SANDWICH - QUENTIN CRISP
MONEY - CARY GRANT
*TREE - GEORGE BUSH
PRIEST - RUSS ABBOT
ORANGE - CILLA BLACK

Object stimuli are the same as in Exp. 6.4 except those marked * which were changed so that line drawings could depict the required names.

Appendix 13:

Figure 2: The Original Version of the model of Proper Name Processing by Valentine, Brennen and Brédart (1996)